DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

ENVIRONMENTAL MANAGEMENT SYSTEMS AT IGNITION COIL PRODUCTION PLANT

by
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İZMİR

ENVIRONMENTAL MANAGEMENT SYSTEMS AT IGNITION COIL PRODUCTION PLANT

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M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled "**ENVIRONMENTAL MANAGEMENT SYSTEMS AT IGNITION COIL PRODUCTION PLANT**" completed by **GÜLRİZ VİDİNLİ** under supervision of **PROF. DR. DENİZ DÖLGEN** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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ENVIRONMENTAL MANAGEMENT SYSTEMS AT IGNITION COIL PRODUCTION PLANT

ABSTRACT

Environmental pollution continuous to increase with increasing industrialization. With new legislations, environmental management systems guide corporations to decrease pollution. Environmental management systems are the most important tool to reduce natural resource consumption and to prevent pollution in an effective and integrated way.

In this study, ISO 14001 Environmental Management System standard requirements and implementation steps are described in details. Ignition coil production plant in the automotive parts industry is selected as study topic. With this scope, procedures and work instructions were established. In this framework, environmental policy was prepared, environmental aspects and impacts procedure was prepared, legal requirements, which the plant must obey, were specified, emergency situation procedure was prepared, internal audit procedure was formed. Ignition coil production processes were determined and examined.

In order to apply the system, environmental aspects and impacts were defined as first in the study. Following to the evaluation, action plans were defined to realize the objectives and targets. Principally, four objectives were defined and actions were delineated. These objectives were (i) management of solid wastes (ii) management of wastewater (iii) management of waste area and chemical warehouse and finally (iv) training of employees.

To realize first objective, types of waste and quantity were analyzed; as a result, plastic (fifteen percent) and domestic waste (thirty one percent) are detected as largest two waste groups. Waste separation at source was started and internal waste transfer was organized. With the start of waste separation at source, waste which could be recycled were recycled by recycling company. By this way, recycling ratio

was increased from forty eight percent to sixty five percent and their environmental impacts were decreased.

Waste water management was realized. To manage waste area and chemical warehouse, new waste areas have been planned, basic requirements of these waste sites defined and constructed. Finally, to increase employee's environmental consciousness, training was started.

Keywords: ISO 14001, Environmental management system, ignition coil production

ATEŞLEME BOBİNİ ÜRETİM TESİSİNDE ÇEVRE YÖNETİM SİSTEMLERİ

ÖZ

Çevre kirliliği sanayileşmeyle birlikte artmaya devam etmektedir. Yürürlüğe konulan yasalarla birlikte çevre yönetim sistemleri de çevre kirliliğinin azaltılması konusunda işletmelere kılavuzluk etmektedir. Çevre yönetim sistemleri sanayide etkin ve bütünleşik bir kirlilik önleme ve kaynak kullanımını azaltılma için geliştirilmiş en önemli araçtır.

Bu çalismada ISO 14001 çevre yönetim sistemi gereklilikleri ve uygulama aşamaları detaylı bir şekilde açıklandı. Çalışma alanı olarak otomotiv yan sanayi sektöründe yer alan ateşleme bobini üretim tesisi seçildi. Bu kapsamda, prosedürler ve çalişma talimatları yayınlandı. Bu çerçevede, çevre politikasi oluşturuldu, çevresel boyut ve etki analiz prosedürü hazırlandı, fabrikanın uyması gereken yasal zorunluluklar belirlendi, acil durum prosedüru hazırlandı, iç denetim prosedürü oluşturuldu. Ateşleme bobini üretim süreçleri incelendi.

İlk olarak, bu sistemi uygulamak için, çevresel etki ve boyutlar tanımlandı. Etkilerin değerlendirilmesinin ardından, amaç ve hedefleri gerçekleştirmek için aksiyon planları tanımlandı. Öncelikle, dört tane hedef tanımladı ve bu hedeflerle ilgili aksiyonlar betimlendi. Bu hedefler (i) katı atıkların yönetimi (ii) atık su yönetimi (iii) atık alan ve kimyasal depo yönetimi son olarak (iv) çalışanların eğitilmesiydi.

İlk amaçı gerçekleştirmek için, atık tür ve miktarları analiz edildi. Tesisten oluşan atıklardan en yüksek miktarda oluşan iki atık evsel atık (yüzde otuzbir) ve plastik atık (yüzde onbeş) olduğu görüldü. Aynı zamanda, atıkların kaynağında ayrıstırılması baslatıldı ve iç atık transferi organize edildi. Atıkların kaynağında ayrıştırılmaya başlanması ile, geri dönüştürülebilen atıklar geri dönüşüm firmaları vasıtasıyla geri dönüştürülmüşlerdir. Böylelikle, geri dönüşüm oranı yüzde kırk

sekizden yüzde altmış beşe yükselmiştir. Ve böylece bu atıkların çevresel etkileri azaltılmıstır.

Atık su yönetimi gerçeklestirildi. Atık alan yönetimi ve kimyasal depo yönetimini gerçekleştirmek için, yeni atık alan ve yeni kimyasal alan planlandı, bu atık alanın temel gereklilikleri tanımlandı ve inşaa edildi. Son amaç olan çalışanların çevre bilincini arttırmak için eğitimler başlatıldı.

Anahtar Kelimeler: ISO 14001, Çevre yönetim sistemi, ateşleme bobini üretimi

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CHAPTER ONE
INTRODUCTION

Environmental issues are one of the most common “hot topics” in the world today’s. For example, measures and preventive actions to control and minimize the wastes have been discussed and investigated for years and as a result, many environmental regulations have been created.

Today, organizations around the world are implementing Environmental Management System (EMS) and certifying them by international standard. For environmental management, ISO 14001 environmental management system standard (ISO 14001) is becoming the leading environmental standard. It specifies the requirements for an EMS, which provides a framework for an organization to control and monitor their environmental impact of company activities, products and services in order to improve their environmental performance continuously.

ISO 14001 is a general guideline to implement EMS. It includes general requirements with guidance for use. In this research, a specific branch of industry is selected, i.e. ignition coil production plant, to implement ISO 14001 and specific EMS guideline is formed.

The objectives of presented thesis are:

- To identify the EMS according to ISO 14001,

- To evaluate a guideline for working on ignition coil production plant, and to show the improving and implementing steps of an EMS for such organizations.

In this study, to realize the objectives, EMS methodology which is Deming cycle has been specified and fundamental principles of EMS and its requirements have been investigated. EMS implementation stages which are environmental policy, planning, implementation and operation, checking and corrective actions,

management review have been explained theoretically in section two. At the following sections, general information about the plant has been given.

At EMS implementation section, environmental policy was formed, environmental aspects and impacts evaluation method was defined and evaluated, objectives and targets were specified, legal requirements which the plant must subject were specified, environmental consciousness training was organized. Management review meeting was organized. In addition, procedures about EMS were prepared. Furthermore, the selected plant is located in X free zone because of that reason the plant subjects to special official procedure. Free zones in Turkey subject to customs regulation. Therefore this special situation changes legal regulations, waste management and waste transfer, transforms to a different process than other industrial zone. In this context, while forming waste management procedure, the special situation was considered.

At the results section, environmental aspect and impact evaluation forms have been presented, evaluation scores were analyzed, necessary action plan which was medium-term action plan was prepared, realization of objectives and targets have been evaluated at environmental management program, and waste quantity has been analyzed. The analysis showed that, plastic and domestic waste had two greatest amount. On the other hand, plant waste was 18% hazardous waste and 82% non-hazardous waste.

Before this study, waste separation at source had not been applied well in the plant. With the start of waste separation at source, as results of this study, recycling ratio was increased from 48% to 65%.

After waste separation at source started, internal waste transfer flow table were defined and organized. Waste water quality was started to follow. Training about environmental consciousness was planned and started. A new chemical warehouse and waste area were constructed and utilized. Management procedures of these new areas were issued.

CHAPTER TWO
ENVIRONMENTAL MANAGEMENT SYSTEM

2.1 Environmental Management System Definition

Environmental perspective of organizations is mentioned as "Organizations are increasingly concerned with achieving and demonstrating sound environmental performance by controlling the impacts of their activities, products and services on the environmental, consistent with their environmental policy and objectives" (International Organization for Standardization, (2004)).

Nowadays, organizations act responsibly about their environmental impacts. These organizations approach highly sensitive to environmental performance as well as to their product quality since a worldwide environmental consciousness is established that leads to increasing sensitivity to environmental issues.

EMS goals are defined as "International standards covering environmental management are intended to provide organizations with the elements of an effective environmental management system that can be integrated with other management requirements and help organizations achieve environmental and economic goals" (International Organization for Standardization, (2004)).

ISO 14001 Environmental Management System Standard is a handbook that guides to organizations at establishing EMS, monitoring environmental performance indicators and improvement of environmental performance.

2.2 Benefits of EMS

Benefits of EMS defined as "ISO 14001 provides management tools for organizations to control their environmental aspects, impacts and to improve their environmental performance" (Erdem, 2006). An EMS can benefit on the company in many ways. EMS could help company these issue below:

- Minimize your environmental aspect and impact
- Compliance with environmental laws and regulations
- Maximize the efficient use of
- Saving consumption of energy and material
- Reduce your waste
- Improved corporate image among regulators, customers and public
- Build awareness of environmental issues among your employees.
- Framework for continuous improvement of your environmental performance
- Reduced environmental accidents

2.3 Method of EMS

This international standard is based on the methodology known as Plan-Do-Check-Act (PDCA). This methodology is named Deming Cycle and presented in Figure 2.1.

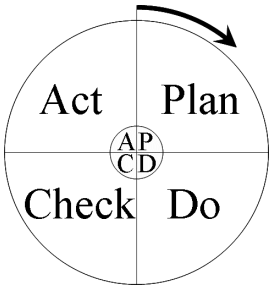

Figure 2.1 The Deming cycle description

PDCA can be described as follows;

- Plan: Establish the objectives and processes to deliver results in accordance with the organizations environmental policy
- Do : İmplement the processes
- Check : Monitor and measure processes against environmental policy , objectives, targets, legal and other requirements, and report the results

• Act: Take actions to continually improve performance of the environmental management system (International Organization for Standardization, 2004, p.3).

2.4 Fundamental Principles of EMS

EMS requirements are described in the following five main elements of the standard.

- Environmental Policy
- Planning
- Implementation and Operation
- Checking and Corrective Action
- Management Review

These five elements based on principles of continual improvement: Plan, Do, Check, Act. Application of Deming cycle in EMS is presented in Figure 2.2.

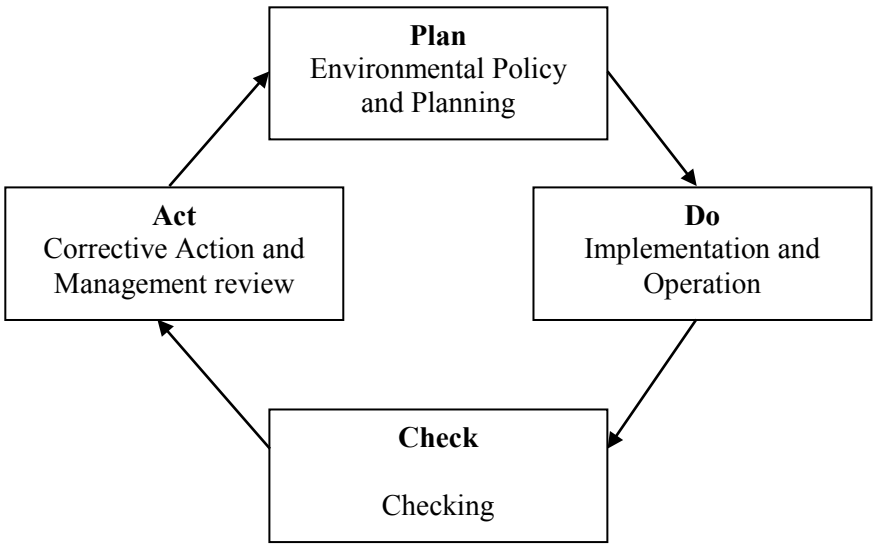

Figure 2.2 Application of Deming cycle in EMS

2.4.1 Environmental Policy

Environmental policy is a formal and documented set of principles and intentions with respect to the environment. Essentially, the environmental policy is the guiding document for corporate environmental improvement and adherence to it is the fundamental integrity and success of the entire EMS (Roberts & Robinson, 1996, p.20).

Environmental policy should be defined and set out the company environmental target and principals by top management.

Environmental policy applications are defined as "The policy should apply to that organization's activities, products, and services. It should reflect the organization's mission and values, and should show commitment, leadership, and direction for the organization's environmental initiatives" (Cascio, Woodside, Michell, 1996, p.30).

ISO 14001 requires an applicable environmental policy that can be developed and implemented.

Environmental policy requires following points in its content:

- Appropriate to the organization's environmental impacts
- Provides a framework for setting environmental objectives and targets
- Commitment to continual improvement
- Commitment to prevention of pollution
- Commitment to comply with environmental laws and regulations, and other requirements to which the organization subscribes
- Document and implement the environmental policy
- Communicate it to all employees
- Commitment to communicate the environmental policy to the public
- Coordination with other organizational policies

- Documented statement of commitment from top management (Virginia Department of Environmental Quality, n.d.).

An executive level manager must sign the environmental policy statement. All employees within the organization must understand and recognize the commitments. In addition, employees of the organization should be able to relate how their job function interacts with the environmental policy statement (Virginia Department of Environmental Quality, n.d.).

2.4.2 Planning

ISO 14001 has three elements that define the planning phase for an EMS. The planning phase must include followings:

- The identification of environmental aspects and impacts of the organizations activities, products and services
- An understanding of legal and other requirements
- Establishment of objectives and targets.

2.4.2.1 Environmental Aspects & Impacts

The process of identifying environmental aspects and impacts is an important cornerstone of an effective EMS.

ISO 14001 requires organizations to;

- Develop procedures to identify environmental aspects in order to determine those which have or can have significant impact on the environment
- Aspects information up-to-date (regularly, and whenever changes occur), not once and done
- Necessary records will include aspects lists, and significant aspects list

Environmental aspect is element of an organization's activities, products, or services that can interact with the environment. Environmental impact is any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services. (Florida Department of Environmental Protection, n.d.).

The aspects may be direct (use of natural resources, use of electricity etc.) or indirect (policymaking, suppliers, environmental aspects etc.). Impacts are the actual or potential changes to the environment resulting from any of the environmental aspects. It is important to identify impacts on air, water, land, ecological resources and human resources (Inno, 2005, p.53).

The identification of the environmental aspects is an ongoing process that determines the past, current and potential impact of an organization's activities on the environment. The process should consider normal operating conditions, shut down and start up conditions, as well as potential significant impacts associated with foreseeable or emergency situations. Organizations do not have to evaluate each product, component or raw material input. They may select categories of activities, products or services to identify those aspects that are likely to have a significant impact (Tekneci, 2004, p.36).

After identifying the environmental aspects of whole facilities, the next step is to determine their impacts on the environment. The focus is to asses each environmental aspect and evaluated how that aspect will impact on the environment. The standard defines environmental impacts as "any chance to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, and services" (Cascio et al., 1996).

Now that all aspects have been identified and their impacts or change to the environment has been determined, the next step is the determination of impact significance. By now, a good description of environmental aspect has been established and now it is the task of the ISO team to take or determine the risk

assessment associated with the aspect. One of the accepted ways to determine which aspects have a greater significance or risk factor is to use a number system. The number system is a way of converting an assigned aspects impact into a significance rating that is determined by ISO team (Shoemaker, 2005, p.96).

It is responsibility of the core team to use a number system that is composed of predetermined criteria categories that it feels will be relevant to the facility. The ISO 14001 standard again only provides guidance in this area, giving only reference to a few areas of focus that should be addressed. Such areas of focus include, emissions to atmosphere, discharge to sewer of controlled waters, contamination of land, waste disposal issue and production, types of substances used in the facilities manufacturing produce, raw material usage, transport and shipping controls, and environmental legislation. Each of the areas needs to be carefully addressed in the risk assessment of determined environmental aspects and impacts (Shoemaker, 2005, p.97).

The numbering system is designed to evaluated the significance level of each predetermined criteria category for a given impact, and assign it on numeric value. The numeric value is then added up for each category and establishes a way of comparing each impact by rating their significance. The scoring system should be applied uniformly to all facilities impacts in order to maintain a consistent level of comparison (Shoemaker, 2005, p.99).

2.4.2.2 Legal Requirements

ISO 14001 defines an environmental component of the planning process which is a procedure for ensuring access to all environmental laws and regulations applicable to the organization's or facility's activities, products and services. The procedure needs to be capable of translating applicable regulatory requirements into plain language that can be communicated clearly to operations and other managers whose responsibilities will be affected (Best Practices Guide:

Application of ISO 14000 Environmental Management Systems for Municipalities n.d., p.12).

After identify and study the related environmental legal and other requirements applicable to organization, organization shall consider and apply these requirements when organizations identify the environmental aspects of the organization.

Organization shall ensure that these environmental legal and other requirements which applicable to organization are taken into account in establishing, implementing and maintaining the EMS.

2.4.2.3 Objectives and Targets

An environmental objective is defined as "an environmental objective as an overall environmental goal, arising from the environmental policy, that an organization sets itself to achieve, and which is quantified wherever possible." (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities n.d, p.13).

An environmental target is defined as "a detailed performance requirement, quantified where practicable, applicable to the organization or parts therefore, that arises from the environmental objectives and that needs to be met in order to achieve those objectives." (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities n.d., p.13).

Two key points to keep in mind are first, that a target is a more detailed, more specific step along the way to achieving an objective; second, that the organization is itself responsible for setting its own objectives and targets based on its knowledge and understanding of its interactions with the environment and the legal and other requirements that apply to it (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities n.d., p.13).

2.4.3 EMS Implementation and Operation

In the ISO 14001 standard, the implementation and operation phase of the standard follows the development of the environmental policy statement and the planning phase. This overall section of the standard discusses the necessary elements for the implementation and operation of the environmental management system. This section of the standard contains seven distinct elements.

- Structure and Responsibility
- Training, Awareness and Competence
- Communications
- Environmental Management System Documentation
- Document Control
- Operation Control
- Emergency Preparedness and Response (Virginia Department of Environmental Quality, n.d.).

2.4.3.1 Resources, Roles, Responsibility and Authority

Three specific tasks must be addressed:

- Responsibilities of each individual and unit within the organization must be defined and documented with respect to the EMS.
- Adequate resources must be provided to implement and maintain the EMS.
- Management representative must be appointed to ensure conformance and continual improvement.

Everyone's role with respect to the EMS must be documented and communicated. In other words, every member of the organization must recognize and understand their role. Top management must commit the resources necessary to support the EMS:

- Manpower,
- Special Skills,
- Technology, and
- Financial (Virginia Department of Environmental Quality, n.d.).

The role of the management representative is critical to the success of an EMS. He or she must be an individual who is trusted and respected by all management levels, with the knowledge and ability to implement the EMS, and with a personal commitment to its success. In this role, the management representative should report directly to the senior manager and be a member of the organizations top decision making group (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities n.d., p.14)

2.4.3.2 Training, Awareness and Competence

The organization must determine overall training needs required for competence with respect to the EMS. Two specific points will need to be addressed under the training, awareness and competence section of the standard. First, the entire organization must receive training that provides a baseline understanding of the concepts underlying the EMS. Second, individuals and units that have the potential to perform activities which could cause significant impact on the environment may require specific technical and skill training related to those impacts. The baseline training that covers the entire organization should cover the following issues:

- Importance of the EMS (environmental policy statement, objectives and targets, etc.)
- Various roles within the organization in achieving and maintaining the EMS
- Consequences of deviating from the EMS

In summary, every individual in the organization must understand the conceptual requirements of the environmental management system and their specific role. The specific technical and skills training should be focused on two distinct areas.

First, training should be provided for individuals and units that are responsible for activities or processes that may create significant environmental impacts. The scope and degree of training will depend upon the complexity of the process and the level of education and experience of the personnel involved. The organization must determine the necessary level of competence required. Second, the individuals and units responsible for emergency preparedness and response should be trained and competent to respond under the procedures developed to respond to those events if and when they occur (Virginia Department of Environmental Quality, n.d.).

2.4.3.3 Communication

Effective communication is an essential foundation of an EMS. Communicating relevant information about the EMS means sharing the power for implementing, maintaining, and improving the EMS. Informed and knowledgeable employees can be active participants in the EMS. Conversely, when communications are inadequate and information is missing, an EMS is weakened.

ISO 14001 mandates that there be clearly-defined procedures for communicating about the EMS within and between the various levels of responsibility, and within and between different functions (i.e., departments, areas of operation) in the organization. There are many basic reasons for such communications; for example:

- To demonstrate management commitment to protecting the environment, preventing pollution, compliance with laws and regulations, and continual improvement of the EMS
- To motivate employees to do likewise
- To respond to concerns about environmental aspects and their impacts
- To raise awareness about the environmental policy, objectives and targets, operating procedures, and the EMS
- To improve understanding by internal and external interested parties about the EMS and the organization's environmental performance.

Some specific and practical requirements for internal communications in ISO 14001 are:

- Environmental policy
- Legal and other requirements
- Significant environmental aspects and impacts
- Environmental objectives and targets
- Changes to activities, products, or services that affect environmental management programs
- Roles and responsibilities in the EMS
- Training, awareness, and competence requirements
- Operating and document control procedures that may affect the environment
- Emergency preparedness and response actions
- Requirements for, and results of, monitoring and measurement
- Environmental incidents
- Non-compliance with laws and regulations
- Non-conformance with the requirements of the EMS
- Corrective and preventive actions and follow-up to ensure effectiveness
- Results of environmental audits
- Information on the EMS to top management
- Results of management reviews of the EMS
- Effectiveness of the EMS

According to ISO 14001, an organization must be open to receiving communications about their EMS, or environmental issues in general, from individuals, groups, agencies, and other organizations outside itself. All such communications should be documented (i.e., written down), recorded (i.e., filed for future reference), and responded to promptly and appropriately.

2.4.3.4 EMS Documentation

Three specific tasks must be addressed under the environmental management system documentation section of the standard. First, the organization must describe the foundation elements of the environmental management system in either paper or electronic format. Second, the preceding description must demonstrate the interaction between the foundation elements of the environmental management system. Third, the description must reference the related documentation (Virginia Department of Environmental Quality, n.d.).

Documentation must include environmental policy, the environmental objectives and targets, the EMS organization showing roles and responsibilities, operational control procedures, monitoring and measurement procedures, and the top management review of the EMS.

EMS documentation requirements are defined as "In addition, the EMS documentation must provide directions or a road map to locate other relevant EMS documents such as environmental training records, EMS audit records, and regulatory permits"(Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities n.d., p.16).

2.4.3.5 Document Control

The EMS must contain a procedure for controlling all documentation required by the EMS. A major purpose of document control is to ensure that all EMS documents can be located, reviewed, revised and approved by authorized persons. Another purpose is to ensure that the current versions of relevant EMS documents (e.g., operational procedures) are available in all locations of the facility where they are essential for the effective implementation of the EMS (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities n.d., p.17).

Aim of document control is defined as "The primary purpose of the document control system is to insure that only the current approved documents are employed in the planning and operation of the environmental management system"(Virginia Department of Environmental Quality, n.d.).

2.4.3.6 Operational Control

Where an operation or activity is complex and/or the potential environmental impacts are significant, these controls should take the form of documented procedures. Procedures can help your organization to ensure regulatory compliance and consistent environmental performance. Procedures can also play a key role in employee training.

Documented procedures should cover those situations where the absence of procedures could lead to deviations from the environmental policy or your objectives and targets. Determining which operations should be covered by documented procedures and how those operations should be controlled is a critical aspect of developing an effective EMS.

In deciding which activities need to be controlled, look beyond routine production on the shop floor. Activities such as maintenance, management of on-site contractors, and relationships with suppliers or vendors could affect your organization's environmental performance significantly (Stapleton, Cooney & Hix Jr., 1996, p.61).

2.4.3.7 Emergency Preparedness and Response

Despite an organization's best efforts, the possibility of accidents and other emergencies still exits. Effective planning and preparation can reduce injuries, protect employees and neighbors, reduce asset losses and minimize production downtime.

An effective emergency preparedness and response program should include provisions for:

- Assessing the potential for accidents and emergencies;
- Preventing incidents and their associated environmental impacts;
- Plans / procedures for responding to incidents;
- Periodic testing of emergency plans / procedures;
- Mitigating impacts associated with these incidents.

Emergency Preparedness and Response Plan must describe the following:

- Potential emergency situations (such as fires, explosions, spills or releases of hazardous materials and natural disasters)
- Hazardous materials used on-site (and their locations)
- Key organizational responsibilities (including emergency coordinator)
- Arrangements with local emergency support providers
- Emergency response procedures, including emergency communication procedures
- Locations and types of emergency response equipment
- Maintenance of emergency response equipment?
- Training / testing of personnel, including the on-site emergency response team (if applicable)
- Testing of alarm / public address systems
- Evacuation routes and exits (map), and assembly points (Stapleton et al., 1996, p.63).

2.4.4 Checking and Corrective Actions

The EMS needs clear procedures to verify and to qualitatively (and quantitatively) measure the effectiveness of the EMS. ISO 14001 refers to this component as checking and corrective action". This means having systems for measuring progress toward stated environmental objectives and targets. It also means having a process for verifying whether operations are in compliance with applicable

environmental regulatory requirements and for periodically auditing conformity of the EMS with municipal standards (and ISO 14001). Deficiencies noted during the checking or evaluation process are called “non-conformities” in the language of ISO. The EMS requires a process for identifying and correcting non-conformities and for taking appropriate preventive actions (Stapleton et al., 1996, p.64).

2.4.4.1 Monitoring and Measurement

Facility’s EMS must include a monitoring and measurement component. Three specific tasks must be addressed under the Monitoring and Measurement section of the standard. First, the organization must establish a documented procedure to monitor and measure on a set frequency the activities that are related to the Significant Environmental Aspects. Second, the organization must ensure that the devices used to monitor and measure the activities are calibrated properly. Third, the organization must establish a documented procedure for evaluating on a set frequency compliance with applicable environmental laws and regulations (Virginia Department of Environmental Quality, n.d.).

2.4.4.2 Non–Conformance, Corrective and Preventive Action

Pişkinöz (2008) mention non-conformance, corrective and preventive action as “The organization shall establish and maintain procedures for defining responsibility and authority for handling and investigating nonconformance, taking action to mitigate any impacts caused, and for initiating and completing corrective and preventive action.”

Three specific tasks must be addressed under the non-conformance and corrective and preventative action section of the standard. First, the organization shall develop a procedure for investigating a nonconformance from the established environmental management system. The procedure must include responsibility and authority for the investigation process. Second, the organization must take the

necessary actions to mitigate impacts related to the nonconformance. Third, the organization will need to modify existing procedures based upon the results of the corrective and preventative analysis phase of the investigation in order to prevent future nonconformance. The purpose of this section of the standard is to provide a process to do the following:

- Document the nonconformance;
- Notify those responsible for the mitigation of the nonconformance;
- Investigate the cause of the nonconformance;
- Establish a corrective action to prevent reoccurrence;
- Modify the existing procedure as a preventative action; and,
- Communicate the changed procedure to the necessary activities within the system (Stapleton et al., 1996, p.69).

It is important to characterize the differentiation of corrective actions from preventative actions within the organization.

Preventive and corrective actions differences are explained as "Preventive actions can include analysis of environmental performance indicators previously discussed to determine probabilities of non-conformance. Corrective action will be the process changes or procedural activities that are initiated if and when the preventative actions detect a problem" (Pişkinöz, 2008).

2.4.4.3 Records

An organization must manage documents associated with the EMS in a manner that ensures they are easily identifiable; regularly reviewed and revised as necessary; available in current versions at all locations where they are needed; and promptly removed from service when obsolete. Similarly, records relevant to the EMS must be controlled in a manner that ensures they are properly collected, identified, indexed, filed, stored, and maintained. Records must also be retained in

accordance with applicable laws, regulations, and/or other requirements to which the organization subscribes (Environmental Protection Agency, n.d.).

2.4.4.4 Environmental Management System Audit

The EMS Audit program is a key requirement for the facility's EMS. The overall purpose of the EMS audit is to determine whether the facility's EMS is meeting EMS standards (or ISO 14001 if it is certified), and whether the EMS is being property implemented and maintained (Virginia Department of Environmental Quality, n.d.).

Four specific tasks must be addressed under the Management System Audit section of the standard. First, the organization must develop a program and related procedures that define an audit plan of the environmental management system. In addition, the program must define frequency of the audit process. Second, the procedures must specify the methodology of the audit process, including the qualifications of the auditors. Third, the audit reports must be submitted to top management. Fourth, the audit reports must provide recommendations directed at correcting any reported nonconformance that was discovered in the audit process (Virginia Department of Environmental Quality, n.d.).

2.4.5 Management Review

The facility's EMS must provide for periodic review of the EMS by top management. The EMS management review is not the same as the EMS audit. The EMS audit looks at the EMS in detail and makes judgments as to whether the EMS is being implemented in accordance with EMS standards (or ISO 14001). The EMS management review uses the results of the EMS audits, performance data gathered through monitoring and measurement, and other information on internal or external factors that pertain to the environmental performance of the organization to ensure the continuing suitability, adequacy and effectiveness of

the EMS (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities n.d., p.19).

Management reviews are the key to continual improvement and to ensuring that the EMS will continue to meet organization needs over time. There are two kinds of people who should be involved in the management review process:

- People who have the right information / knowledge
- People who can make decisions (Stapleton et al., 1996, p.65).

CHAPTER THREE
GENERAL INFORMATION ABOUT IGNITION COIL PRODUCTION PLANT

3.1 General

In this study, an ignition coil production sector is used as a case study to implement the ISO 14001. The ignition coil production plant has been manufacturing in a defined area, i.e. free zone. Definition of free zone is given below.

> An area where its borders are decided by council of ministers with the aim to support investments and production for exports, to increase the rate of direct foreign investments and technology transfer in to the country, to encourage organizations for export trading activities and increase international trade volume. (Article 1 of the Free Zone Law, numbered 3218, issued date June 6, 1985 (published in Official Journal numbered 18785 and dated June 15, 1985)).

Therefore, since the plant was constructed in X Free zone, the company is foreign investor and has many factories in different parts of world. It has being managed with ISO 9001-2000 Quality Management System and ISO 16949-2002 Quality Management System. The information regarding to manufacturing processes and other facilities are presented in this chapter.

3.2 Facility Description

The plant is located on 80000 square meter area. It has two production buildings, one social facility, one utilities building. There are 1300 employees, who are qualified in their field in the plant. 1210 employees work as blue collar workers and 90 employees work as white collar workers.

The plant is producing ignition coil and spare part which is used in automobile. The international company supplies ignition coil for automotive industry.

3.3 Process Description

Whole production process is shown at Figure 3.1 below. The plant includes two main production parts. These are plastic production (plastic semi-finished production) and ignition coil production.

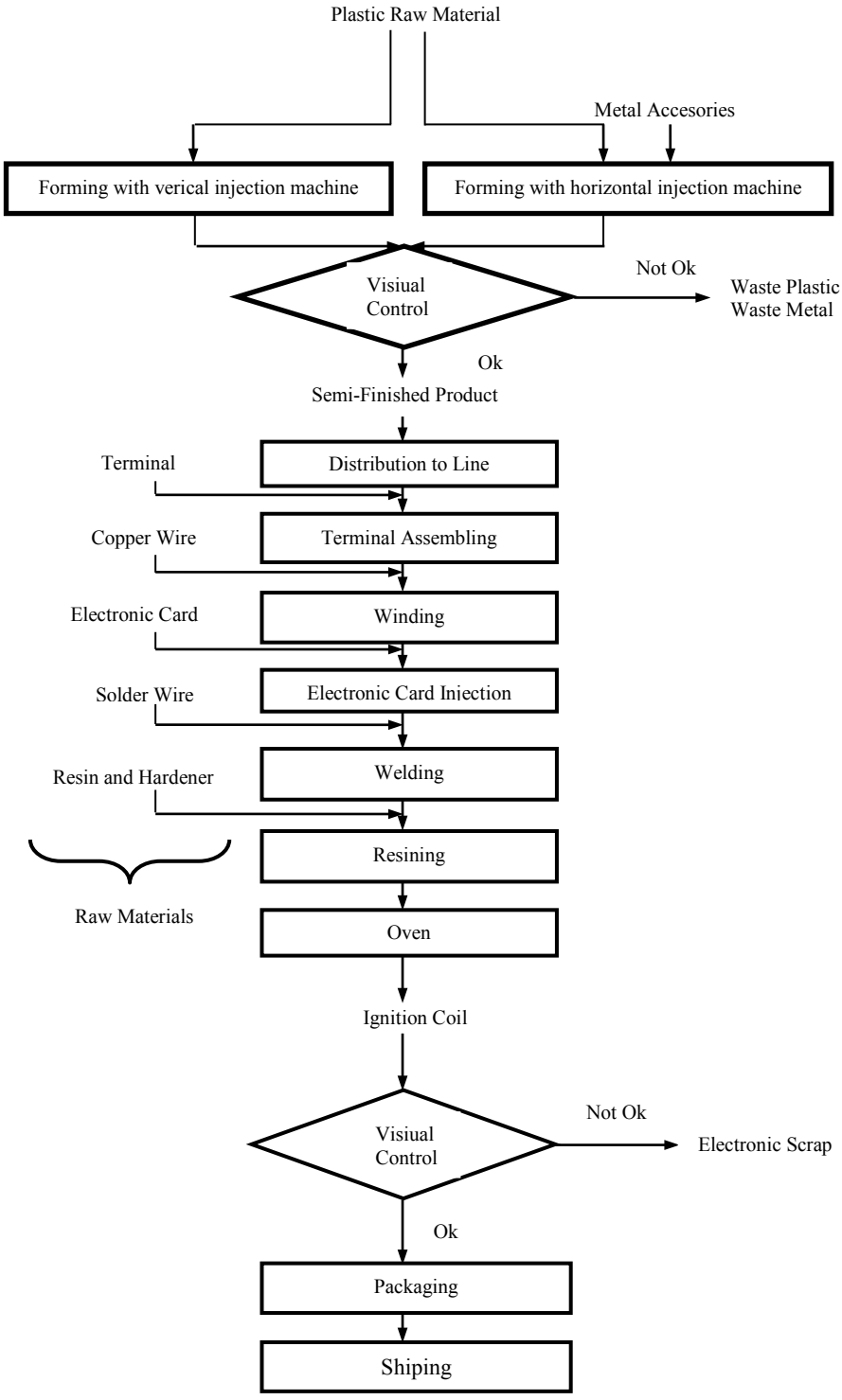

Figure 3.1 Production process description

3.3.1 Plastic Semi-Finished Production

In this process, granule raw materials are formed with temperature and pressure by vertical and horizontal injection machines.

In vertical injection machine, plastic raw materials are formed without metal accessories. Plastic raw materials are loaded to vertical injection machines by transferring systems. Then vertical injection machines start to form automatically with pressure and temperature. After forming, semi-finished products are moved in line by automatic transporting systems. Operators control (visual check) every single semi-finished product used ignition coil production. After operators visual check, semi-finished product are placed on packages by operators. If semi-finished products are not suitable for quality standard, operators send the product into plastic waste. In this vertical injection process, operators work as controller.

In horizontal injection machine, plastic raw materials are formed with metal accessories added by operators.

Plastic raw materials are loaded to horizontal injection machines by transferring systems. Then horizontal injection machines start to form automatically with pressure and temperature. After forming, operators add metal accessories to horizontal injection machine; horizontal injection machines combine formed plastic and metal accessories. Operators control (visual check) every single semi-finished product used ignition coil production. After operators visual check, semi-finished product are placed on packages by operators. If semi-finished products are not suitable for quality standard, operators send the product into plastic waste.

Plastic production process is shown at Figure 3.2 below.

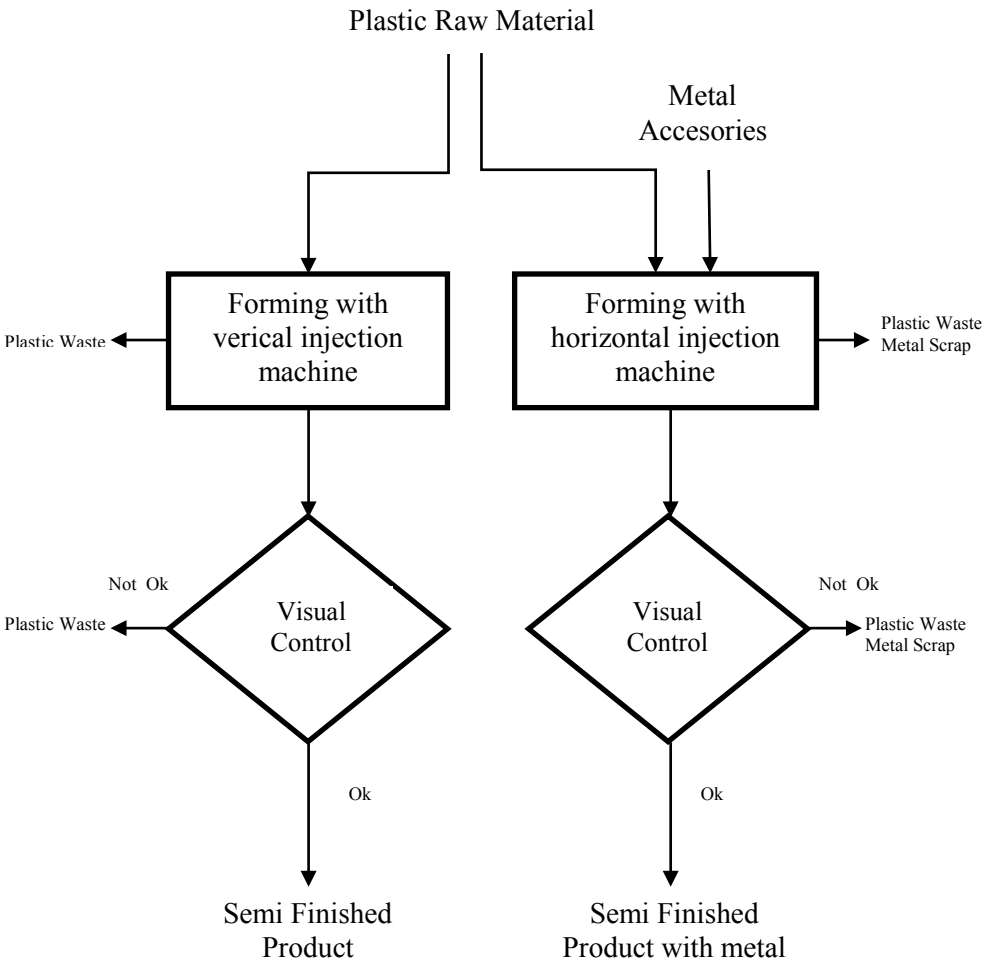

Figure 3.2 Plastic production process description

3.3.2 Ignition Coil Production

Ignition coil production has two different products. These are;

- Ignition Coil for automobile
- Ignition Coil for heavy vehicle

To product coils for automobile and heavy vehicles, semi-finished products produced from plastic production part, are processed mechanically.

Mechanical processes used in the production are listed below;

- Terminal Assembling
- Winding
- Electronic Card injection
- Welding
- Resining
- Oven

Terminals are placed to lines by operator. By product plastic pieces also placed to automate lines in the meantime. Operators' start-up line production and lines start operating fully automated. Through line production, terminals and by-product plastic pieces are merged which is a mechanical operation. This is first step and it called assembling. Then, copper wire is winded to semi-finished product by automatic lines. To wind copper wire, lines need wire in different thickness.

After winding process, electronic card is put by automatic lines in the electronic card injection stage. Following to the electronic card injection, it is welded with solder by automatic lines. Ignition coil is filled by automatic filling systems with resin and hardener mix. Before filling, hardener and resin mix is prepared special proportion.

As a last step, ignition coil is put to the oven. Two different ovens are used in this process. The aim of the process is to dry the resin and to make hardener the mix. After resin is filled, ignition coil is transfer to first oven by operators. Function of first oven is to evaporate moisture. And then, ignition coil is transferred to automatic lines by operators. Hardener and resin level are controlled in the lines. If it is necessary, extra hardener and resin is added by automatic filling system. After controlling, ignition coil is transfer second oven by automatic transfer system. The aim of second oven is to dry at high temperature and to solidify resin and hardener mix. Ignition coil production process is shown in Figure 3.3 below.

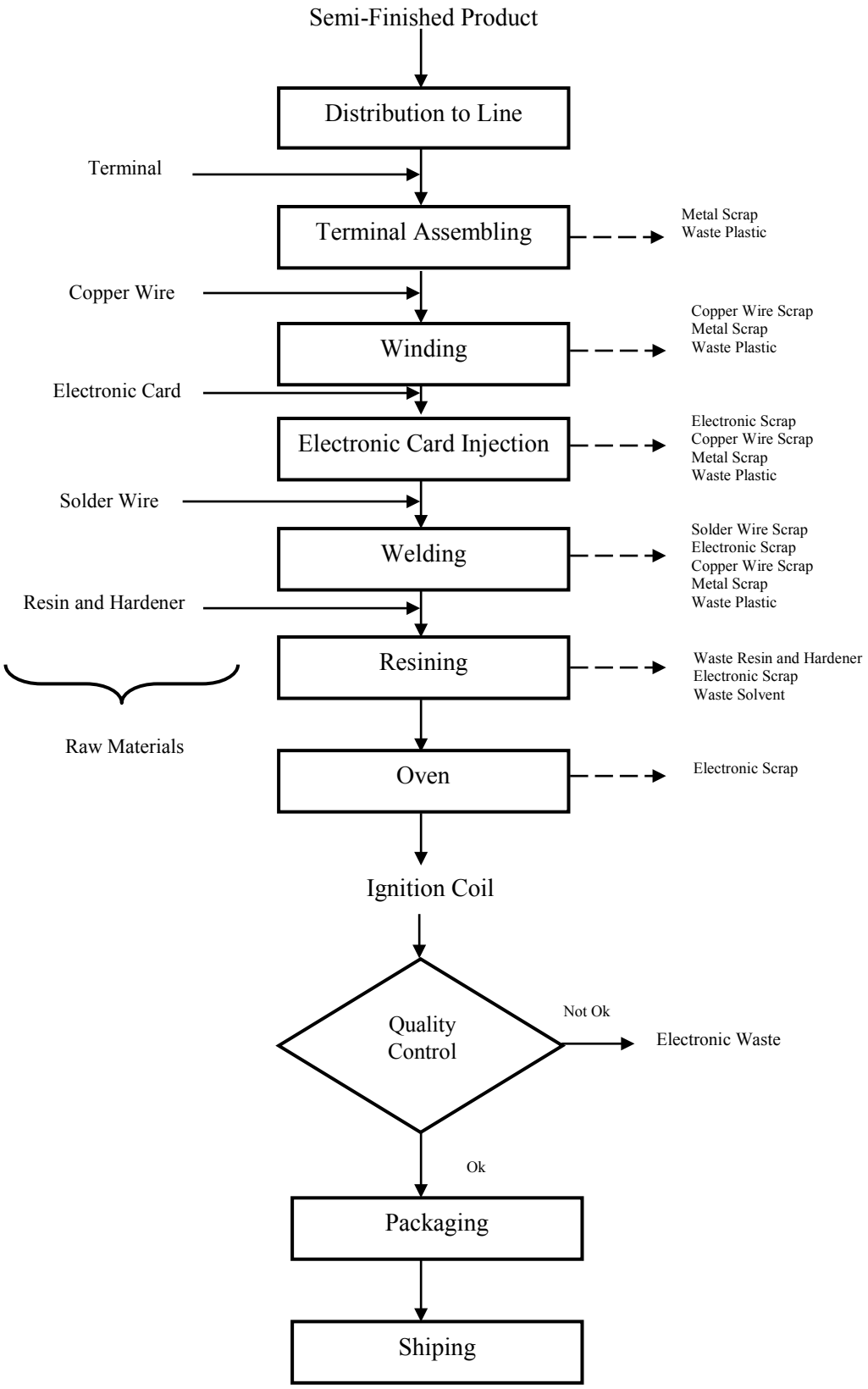

Figure 3.3 Ignition coil production process description

3.4 Raw Materials Used In Process

Granules plastic materials and metal accessories are used in plastic production while resins, hardener, plastic semi-finished products, copper wire, metal accessories, electronic card, and solder wire are used in ignition coil production processes.

In addition to these raw materials, chemicals are also used in the production for cleaning, maintenance, production purposes. These chemicals are alcohol, grease, solder, resin, hardener, silicon, solvent, thinner, oil, glue, cleaner.

Among them, solder, resin, hardener, silicon, thinner and glue are used in production process. Alcohol, solvent and thinner are used for the cleaning of the lines. In maintenance workshop and automation workshop, operators and technicians used alcohol, cleaner, grease, solvent, thinner, glue, and oil for cleaning aims and maintenance aim.

3.5 Types of Waste and Waste Sources

In order to establish an EMS, definition of wastes and their sources have to be stated. The wastes including types, sources as well as their names are presented in Table 3.1. At Table 3.1, wastes are listed respectively to outflow from process.

Table 3.1 The waste generated from the ignition coil production

Output Waste	Input	Type	Source
Waste plastic	Plastic granule, semi-finish plastic product	Non-hazardous	Plastic production lines, ignition coil production lines and warehouse
Metal scrap	Metal accessories	Non-hazardous	Plastic production lines and ignition coil production lines
Copper wire scrap	Copper wire	Non-hazardous	Ignition coil production lines
Electronic Scrap	Plastic semi-finished product, metal accessories, copper wire, electronic card	Hazardous	Ignition coil production lines, quality and IT department
Solder wire scrap	Solder wire	Hazardous	Ignition coil production lines
Waste resin and hardener (Liquid)	Resin and hardener	Hazardous	Resin lines(in Ignition coil production part)
Waste solvent	Solvent	Hazardous	Resin lines (in Ignition coil production part)
Waste resin (Solid)	Resin	Non-hazardous	Resin lines(in Ignition coil production part)
Contaminated empty drum	Resin and hardener drum's	Hazardous	Ignition coil production lines
Waste oil	Oil	Hazardous	Production lines and workplace
Contaminated waste	Absorbent material and chemical	Hazardous	Production lines and workplace
Contaminated packaging	Chemical packaging	Hazardous	Production lines and workplace
Waste packaging	Paper and packaging	Non-hazardous	Production lines and packaging area
Wooden pallet	Pallet	Non-hazardous	Warehouse
Waste fluorescence	Florescence	Hazardous	Lighting equipment
Waste accumulator	Accumulator	Hazardous	Changing the finished batteries of equipment's
Waste batteries	Batteries	Hazardous	Offices
Waste cartridge	Cartridge	Hazardous	Offices
Domestic waste	Food, paper	Non-hazardous	Dining hall and toilets
Medical waste	Medical material	Hazardous	Health office

Besides solid wastes, waste water are generated from domestic uses, i.e. toilets, kitchen, etc. Since water is not used during the processes, wastewater from the production is not produced. In the examined plant, in order to manage the wastewater, quantity (i.e. flow rate) and sources are identified.

In present condition, there are 1300 employees in the plant. Thus, wastewater flow rate is calculated as 130 m^3 per day considering the employees and their specific water consumptions (see following equation).

$$Q = N \times q / 1000 \quad (3.1)$$

N = Number of employees

q = 100 l / person x day

(Metcalf & Eddy, 2003)

$$Q = N \times q / 1000$$

$$Q = (1300 \text{ person}) \times (100 \text{ l /person x day}) / 1000$$

$$Q = 130 \text{ } m^3/\text{day}$$

There are nine chimneys in the plant (two boiler chimneys, generator chimney, resin aspiration chimney, five aspiration chimneys). Additionally exhaust gases emissions are other sources in the plant.

Two boiler chimneys are located in utilities buildings which has two boilers. Resin aspiration chimney is located in ignition coil production building. Aspiration chimneys involve two different types. One of types of chimney is plastic production part chimneys and the other one is ignition coil production part chimneys.

3.6 Consumption of Natural Sources

Natural sources such as water, natural gas, and diesel fuel are used in the production.

Water is used by employees for domestic requirements in the plant. In present situation, water is provided from municipality water supply system. The water consumption during the years 2011 and 2012 is shown in Table 3.2.

Table 3.2 Water consumption in plant during 2011-2012

2011				2012			
First Quarter	**Second Quarter**	**Third Quarter**	**Fourth Quarter**	**First Quarter**	**Second Quarter**	**Third Quarter**	**Fourth Quarter**
5414 m^3	5446 m^3	6886 m^3	4138 m^3	3160 m^3	5037 m^3	8094 m^3	6595 m^3

In winter seasons, natural gas is used by boilers for heating. In present situation, natural gas is provided by the administration of free zone which comes from private corporation. The natural gas consumption during the years 2011 and 2012 is shown in Table 3.3.

Table 3.3 Natural gas consumption in plant during 2011-2012

2011				2012			
First Quarter	**Second Quarter**	**Third Quarter**	**Fourth Quarter**	**First Quarter**	**Second Quarter**	**Third Quarter**	**Fourth Quarter**
82096 Sm^3	4927 Sm^3	0 Sm^3	20928 Sm^3	90113 Sm^3	6775 Sm^3	0 Sm^3	25647 Sm^3

In addition, diesel fuel is used in the plant to operate the generator. Therefore, certain amount of diesel fuel is used to supply electrical energy for the outage times.

Electrical energy is also used in plant for production, lighting and communication. The electrical energy consumption during the years 2011 and 2012 is shown in Table 3.4.

Table 3.4 Electrical energy consumption in plant during 2011-2012

2011				2012			
First Quarter	**Second Quarter**	**Third Quarter**	**Fourth Quarter**	**First Quarter**	**Second Quarter**	**Third Quarter**	**Fourth Quarter**
1138841 kWh	1426196 kWh	1748223 kWh	1425898 kWh	1505427 kWh	1749297 kWh	1843501 kWh	1637747 kWh

CHAPTER FOUR
CASE STUDY: APPLICATIONS OF ENVIRONMENTAL MANAGEMENT SYSTEMS IN IGNITION COIL PRODUCTION PLANT

4.1 Methodology

Deming cycle, which based on continual improvement, was chosen for methodology in this study. Deming cycle depends on basic five elements. These are plan stage, do stage, check stage and act stage.

At plan stage, environmental policy was prepared, environmental aspects and impacts evaluation method were defined, objectives and targets were specified, legal requirements table, which were applicable regulations for the plant, were specified and environmental management program was formed.

At do stage, responsibilities were defined, trainings which were needed were specified, internal and external communications were provided, operational control parameter were defined and controls were provided, emergency hand book was formed.

At the check stage, environmental parameters which should be measured were defined, monitored and measured, to monitor environmental performance, procedures were prepared. These procedures were chemical warehouse management, waste management and waste area management. Environmental management audit system was established.

At the act stage, management review was provided. It means management review meeting was planned and organized. Details are given in the following sections.

4.2 Environmental Policy

At the beginning of the implementation of the ISO 14001 EMS standard, environmental policy was prepared. The policy was approved and committed by the general director of plant. The environmental policy of ignition coil production plant is shown in Figure 4.1.

ENVIRONMENTAL POLICY

To protect environment and to measure up all supplies, employees and other partnerrequest w commit to following principles below,

- Ensure laws, regulations and customer requests for implementing our production and other activities.
- Reduce the amount of waste and manage their environmental impacts.
- Save natural sources during production and other activities.
- Ensure ISO 14001 EMS requirements and ensure continuous improvement.
- Prevent pollution during production and other activities.
- Organize environmental communication system which includes workers, suppliers, sub-contractors, customers, public authorities.
- Train workers to improve general environmental awareness.

General Director

Figure 4.1 Environmental policy of ignition coil production plant

The policy was informed to all employees, suppliers, sub-contractors, customers and public authorities. It was published and applied.

4.3 Organizational Structure of Environmental Management System

Organizational structure of EMS was occurred in the plant and is shown in Figure 4.2.

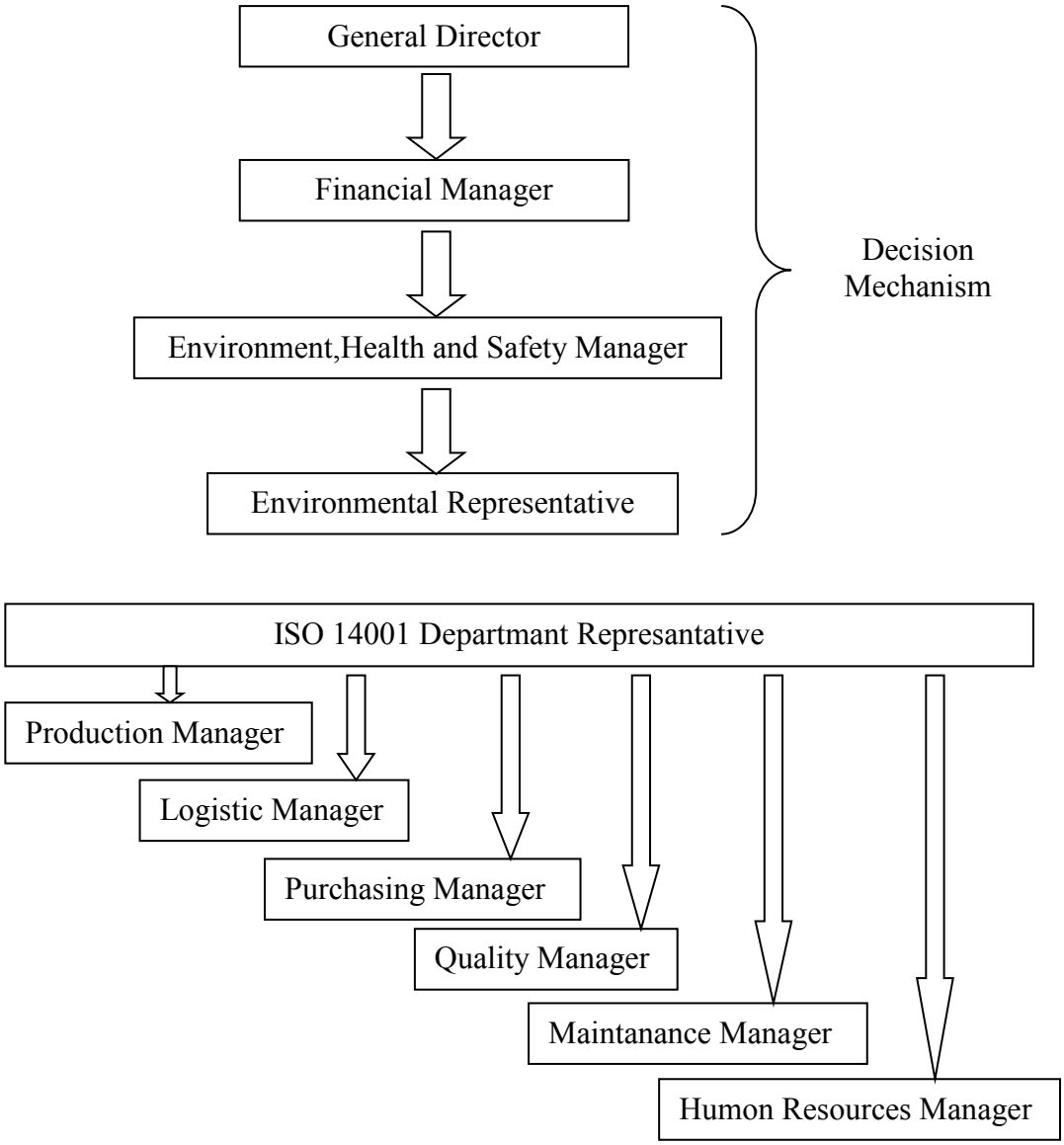

Figure 4.2 Organizational structure of EMS

4.4 Planning

4.4.1 Environmental Aspects & Impacts

To define the plant's environmental aspects and impacts, environmental aspects and impacts evaluation form has to be prepared and environmental aspect and impacts evaluations have to be calculated for each environmental aspect. The evaluation form was established and presented in Table 4.1.

Environmental impacts were considered under the topics of legal obligations, impact area, frequency, probability of emergency situations, natural sources consumption. Environmental aspect and impact evaluation was applied all area in the ignition coil production plant. Environmental representative and department representative work together for the evaluation.

The sample of environmental aspect and impact evaluation form format and the calculation method is given below in Table 4.1.

Table 4.1 The sample environmental aspect & impact evaluation form format of the plant

No	Aspect	Impact	Source	P1	P2		P3	P4	P5	Score	Normal	Abnormal	Emergency

The criterias of the environmental impact and aspect evaluation are below.

P1 symbolizes legal obligations. There are three alternative points for P1 boxes. The three alternative points and its meanings are explained below,

- If there is legal obligations about related impacts and if related impact is not suitable to the legal obligations, point must be filled as four.
- If there is legal obligations about related impacts and if related impact is suitable to the legal obligations, point must be filled as two.
- If there is no legal obligation about related impacts, point must be filled as one.

P2 symbolizes impact area. There are six options for P2. These are air, water, soil, flora, fauna and human.

•If environmental impact affects air, “a” must be written at first P2 box in environmental aspect and impact form.

•If environmental impact affects water, “w” must be written at first P2 box in environmental aspect and impact form.

•If environmental impact affects soil, “s” must be written at first P2 box in environmental aspect and impact form.

•If environmental impact affects flora, “f” must be written at first P2 box in environmental aspect and impact form.

•If environmental impact affects fauna, “f-1” must be written at first P2 box in environmental aspect and impact form.

•If environmental impact affects human, “h” must be written at first P2 box in environmental aspect and impact form.

If environmental impact affects only one area (for example air), P2’s score must be two points since as each area has a value of two. If environmental impact affects more than one area, P2 score must be calculated. The calculation is given below;

$$\text{P2's score} = 2 \times \text{Number of character in first P2 box} \qquad (4.1)$$

In addition, if environmental impact does not affect any area, P2 score is one point.

P3 symbolizes frequency. There are four options for P3. These options and its meanings are explained below,

- If aspect occurs once a day, point must be filled as four.
- If aspect occurs once a week, point must be filled as three.
- If aspect occurs once a month, point must be filled as two.
- If aspect occurs once a year, point must be filled as one.

P4 symbolizes probability emergency situation. There are two options for P4. These options and its meanings are explained below,

- If there is probability to occur an emergency situation, point must be filled as four.
- If there is no probability to occur an emergency situation, point must be filled as one.

P5 symbolizes consumption of natural sources. There are two options for P5. These options and its meanings are explained below,

- If there is consumption of natural sources, point must be filled as four.
- If there is no consumption of natural sources, point must be filled as one.

The formulation of the environmental impact and aspect evaluation score is given below.

$$\text{Environmental aspect score} = (P1xP2xP3xP4xP5) \quad (4.2)$$

The environmental aspect and impact score is defined. The definition is given below;

- If environmental aspect and impact score is between 0 - 50, extended action is taken.
- If environmental aspect and impact score is between 50-70, medium term action is taken.
- If environmental aspect and impact score is higher than 70, immediate action is taken.

Environmental aspect and impact evaluation should be reviewed each year by environmental representative. On the other hand, if there is a new development (For example: new machine or new building) in the plant, special environmental aspect and impact evaluation must be formed and calculated immediately. Furthermore, if there is a new legislation, environmental aspect and impact evaluation must be done over again and reviewed.

Flowchart of environmental aspect and impact evaluation is shown in Figure 4.3 below.

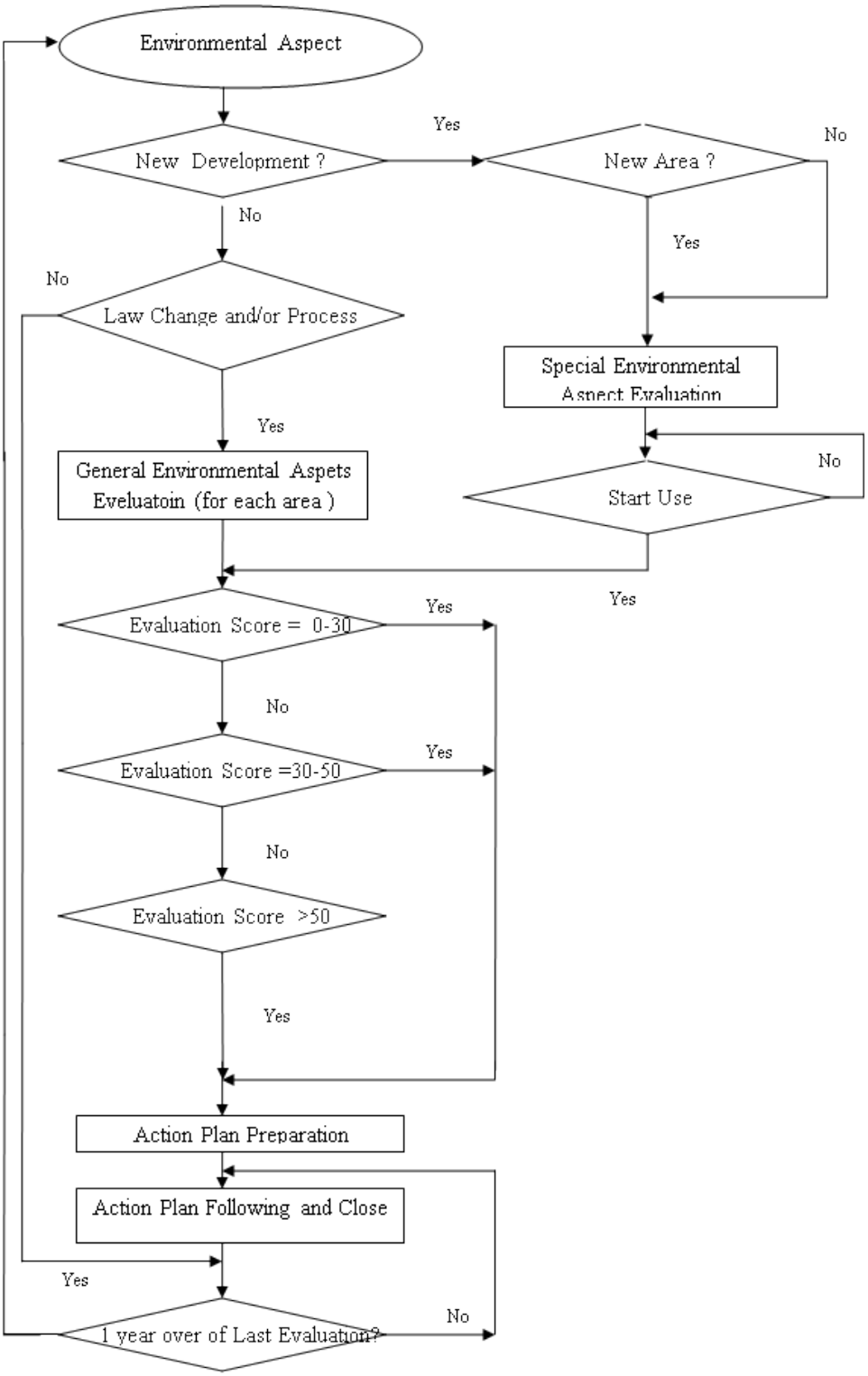

Figure 4.3 Flowchart of environmental aspect and impact evaluation

4.4.2 Objectives and Targets

The environmental objectives and targets of ignition coil production plant were specified. Defined objectives and targets is presented below,

- Objective 1 : To manage solid waste
  - Target 1.1: To provide segregated collection of all solid wastes in its source.
  - Target 1.2: To provide 10% increase of recycling ratio.
  - Target 1.3: To improve internal waste transfer.
- Objective 2 : To manage waste water
  - Target 2.1: To keep wastewater analyzes under control.
- Objective 3 : To manage waste area and chemical warehouse
  - Target 3.1: To build up new waste area and to improve storage conditions in chemical materials warehouse.
- Objective 4 : To train employees about environmental consciousness
  - Target 4.1: To organize trainings about environmental consciousness for newcomers.
  - Target 4.2: To organize special training for all positions.

4.4.3 Legal Requirements

Legal requirements that the plant should follow are considered in this part of the study. All legal requirements were reviewed and legal requirements table, which are applicable regulations for the plant, were specified. The legal requirements table, which is Table 4.2, is listed below.

Table 4.2 Related environmental laws and regulations of the factory

Nbr	Official Journal Date (Last Update)	Official Journal No (Last Update)	Name of Legislation
1	11.08.1983 (08.07.2009)	18132 27282	Environmental law
2	6.17.2011	27967	Soil pollution control and point source contaminated sites regulation compliance certificate regulation
3	6.17.2011	27967	Some non-hazardous waste recovery regulation
4	10.10.2009	27372	Water pollution control regulation sampling and analysis methods
5	3.11.2002	24692	Preparation of safety data sheet procedures and principles regulation
6	10.22.1976	15742	Regulation on the transport of hazardous material by road
7	14.03.1991 (26.03.2010)	20814 27533	Solid waste control regulation
8	18.03.2004 (26.03.2010)	25406 27533	The control of excavation soil, building and wreckage wastes regulation
9	31.08.2004 (30.03.2010)	25569 27537	The control of waste battery and accumulator regulation
10	31.12.2004 (24.04.2011)	25687 27914	Water pollution control regulation
11	07.02.2009	27134	Air pollution control is occurred heating regulation
12	14.03.2005 (30.10.2010)	25755 27744	Hazardous waste control regulation
13	14.03.2005 (30.10.2010)	25755	Hazardous waste control regulation appendix
14	22.07.2005 (03.12.2011)	25883 28131	Medical wastes control regulation
15	10.08.2005 (03.07.2011)	25902 27983	Open a business regulation
16	01.08.2006	26047	Municipial waste water treatment regulation
17	25.11.2006 (30.03.2010)	26357 27537	End of life tire control regulation
18	30.12.2006	26392	Used in outdoor equipment related to the noise emission in the environment by regulation
19	31.03.2007 (18.12.2010)	26479 27789	Regulation on the transport of hazardous material by road

Table 4.2 Related environmental laws and regulations of the factory (continue)

Nbr	Official Journal Date (Last Update)	Official Journal No (Last Update)	Name of Legislation
20	06.06.2008 (05.05.2009)	26898 27219	Air quality evaluation and management regulation
21	05.07.2008	26927	Waste management about general principial regulation
22	03.10.2013	28784	Environmental impact evaluation regulation
23	30.07.2008 (30.03.2010)	26952 27537	Waste oil control regulation
24	25.10.2008 (31.12.2010)	27035 27802	Energy resources and increasing efficiency in the regulation on energy use
25	21.11.2008 (16.08.2011)	27061 28027	Environmental audit regulation
26	26.12.2008 (20.03.2011)	27092 27880	Certain hazardous substances, preparations and articles production, marketing and use restrictions relating to the regulation
27	26.12.2008 (23.05.2010)	27092 27589	Chemical inventory and contol regulation
28	26.12.2008	27092	Safety data sheets on hazardous materials and preparations to the regulation on preparation and distribution of
29	26.12.2008	27092	Dangerous substances and preparations classification, packaging and labeling regulation
30	04.04.2009	27190	Exhaust gas emission control regulation
31	10.09.2014	29115	Regulation on permission and licences required by environmental law
32	4.22.2009	27208	Union of chambers of turkish engineers and architects chamber of environmental engineers environmental engineering services application free, registration supervision and regulation on the minimum wage
33	03.07.2009 (10.10.2011)	27277 28080	Air pollution contol that is occurred by industrial facility regulation
34	26.3.2010	27533	Directive on the landfill of waste regulation
35	4.6.2010 (27.4.2011)	27601	Assessment and management of environmental noise directive regulation
36	8.6.2010	27605	Soil pollution control and point source contaminated sites regulation compliance certificate regulation

Table 4.2 Related environmental laws and regulations of the factory (continue)

Nbr	Official Journal Date (Last Update)	Official Journal No (Last Update)	Name of Legislation
37	30.12.2013	28867	Regulation on the control of major industrial accidents
38	19.07.2013	28712	Odor causing emissions control regulation
39	06.10.2010	27721	Regarding the waste incineration directive
40	21.11.2013	28828	Regulation on environmental officer and environmental consulting firms
41	24.08.2011	28035	Package wastes control regulation
42	27.10.2011	28097	Energy resources and increasing efficiency in the regulation on energy use
43	10.03.2010 (22.04.2010)	21520 27560	Free zones application regulation
44	7.5.2008	2560/3009	Izmir General Directorate of Water and Sewerage administration discharge of wastewater to sewerage system regulation

4.4.4 Environmental Management Program

The organization shall establish, implement and maintain a program and achieving its objectives and targets. Program shall include,

- Designation of responsibilities to achieve its objectives and targets at relevant functions and levels of the organizations,
- The means and time-frame by which they are to be achieved (International Organization for Standardization, (2004)).

Because of that requirement, environmental management program which includes targets and objectives was formed within the framework of study.

4.5 Implementation and Operation

4.5.1 Structure and Responsibility

To establish, implement and improve EMS, top management should guarantee the related sources. The related sources are human resources, technologic and financial sources.

Responsibilities should be described for EMS efficiency. General director, financial manager and environmental representative responsibilities were defined as a part of this study. These responsibilities are presented below;

General Director;

- To approve and guarantee environmental policy and other related documents.
- To set budget for the EMS requirements.
- To provide support about EMS implementation.
- To follow environmental management program reports

Financial Manager;

- To plan budget which includes environmental expense
- To organize all financial sources to environmental objectives and targets.

Environmental representative;

- To organize and manage internal-external waste transfer.
- To manage and control waste area about leakage and cleaning.
- To prepare official papers for waste commission and to apply waste commission to give permission for waste transfer.
- To participate in waste commission meetings in Free Zone.
- To archive waste transfer documents.

- To declare legal notifications.
- To follow environmental legislation.
- To give orientation training for newcomers and to give special training for all positions.
- To review environment bulletin board each month.
- To follow periodical analysis
- To organize EMS meeting and to prepare presentation for the meeting
- To organize and make internal audit and to prepare internal audit report for top management.
- To control implementation of ISO 14001 EMS standards requirements
- To analyze environmental aspect and impact evaluation
- To control environmental aspect and impact action plan.
- To provide internal and external communication about EMS

4.5.2 Training, Awareness and Competence

Human resources department organizes all internal and external trainings for employees which work in ignition coil production plant. The internal trainings contain two different topics. These are orientation training and special training for positions.

If there are any newcomers in the plant, they have to participate orientation training. Orientation training contains several topics. These topics are given below;

- Working rules, training is lectured by human resources department.
- Quality training is lectured by quality engineer.
- Health and safety training is lectured by safety engineer.
- Departmental presentations are given by departmental assistants.
- Environment training is lectured by environmental engineer.

At the end of orientation training, special tests are conducted by trainers. Test results are evaluated and if necessary, orientation training should be reviewed again.

Environment training contents was reviewed in this part of the study. Reviewed content is given below;

- Definition of environment
- Environmental policy
- Consciousness of environment
- Natural sources
- Waste
- Waste management
- Definition of ISO 14001 and EMS
- Responsibly about environment

Special training should be prepared for each special position because each positions environmental effect can be different. In this part of study, required special trainings were listed below;

- Special training 1 : Segregation of waste
- Special training 2 : Chemical Leakage
- Special training 3 : Usage of waste area
- Special training 4 : Usage of chemical area
- Special training 5 : Internal waste transfer
- Special training 6 : Emergency Situation

Environment engineer and human resource department should organize trainings together. Trainings should be planned annually.

4.5.3 Communication

Environmental engineer carries out external communication between public authorities, suppliers and other partners about environmental issues.

To provide internal communication, each department should communicate other department. At the plant, internal communication was provided by the tools below;

- Telephone/mobile telephone
- Fax
- Letter
- Cargo
- E-mail
- Internal communication bulletin board
- Meetings and trainings
- Internal write-ups
- Suggestion boxes

4.5.4 Documentation

To implement and provide conformation of EMS, environmental engineer is responsible for preparing, controlling, updating related documents. Documents are reviewed annually but if there is a new change, related document must be updated immediately.

At ignition coil production plant, documents are placed into specially programed computer.

Documents which are given below were prepared as part of this study;

- EMS hand book,
- Environmental policy
- Environmental objective and targets
- Organizational Structure of EMS
- Environmental management program
- Environmental procedures and instructions
- Management review meeting records

- Emergency situation hand book

Environmental procedures, which were prepared as a part of this study, include below;

- Environmental aspects and impact evaluation procedure
- Follow Legal requirements procedure
- Environmental training procedure
- Document control procedure
- Operation control procedure
- Internal audit procedure
- Corrective and preventive action procedure
- Waste transfer from free zone procedure

4.5.5 Operational Control

While environmental aspect and impact evaluation, seven main environmental impacts were found must be controlled under operational control. These are given below,

- Chemical Materials
- Non-hazardous waste
- Hazardous waste
- Domestic wastewater
- Emissions
- Natural Sources consumption
- Noise

To control chemical materials, chemical list was formed that includes all chemical used in the plant. The list contained hazardous level and storing conditions of these chemicals according to Material Safety Data Sheet (MSDS). To provide MSDS of all chemical materials is in purchasing department responsibilities. Purchasing

department sends MSDS to environmental engineer and chemical list was prepared and updated by environmental engineer. Environmental engineer must keep and archive all MSDS. The list was placed bulletin board in the plant.

Non-hazardous wastes are paper-cardboard, domestic, metal, wire, wooden pallet, and plastic. Suitable waste containers were placed in necessary area where sources non-hazardous waste .Non-hazardous wastes were collected in their sources. Except domestic waste, non-hazardous wastes were sold and recycled by recycling company which had recycling license from T.C. Environment and Forest Ministry. Environmental engineer responsibilities are to manage collection, storage, transporting and disposing methods of non-hazardous wastes.

Waste solvent, alcohol, oil, flux, resin, hardener, contaminated packaging, fluorescence, battery, accumulator, electronic and medical waste are hazardous waste which are occurred in the plant. Suitable waste containers were placed in necessary area where sources hazardous waste. Hazardous wastes were also collected in their sources and they were carried by responsible cleaning personnel according to internal waste transfer procedure. Hazardous wastes were disposed by combustion, storage by related disposal firms or recycled by related recycled company according to the regulation. Hazardous wastes were transported to disposal or recycled company by vehicles which had hazardous waste transporting license from authorized company. Environmental engineer manages collection, storage, transporting and disposing methods of hazardous wastes.

Only domestic waste water is occurred in the plant. The waste water was discharged municipal waste water sewerage system in free zone. To discharge waste water in municipal system, waste water quality must be acceptable to the discharge criteria that are defined by Directorate General of Izmir Water and Sewerage Administration in Regulation of Wastewater Discharge to Sewerage System.

The discharge criteria are given at Table 4.3 (Directorate General of Izmir Water and Sewage Administration, 1991).

Table 4.3 The discharge criteria which are in the regulation

Parameter	Standart
Temperature (^{o}C)	40
pH	6.5-10.0
Total Suspended Solid (mg/l)	500
Oil (mg/l)	250
Chemical oxygen demand (mg/l)	4000
Sulphate (SO4) (mg/l)	1000
Sulfide (S=) (mg/l)	2
Phenol (mg/l)	10
Free chlorine (mg/l)	10
Arsenic (mg/l)	3
Total cyanide (mg/l)	10
Lead (Pb) (mg/l)	3
Cadmium (Cd) (mg/l)	2
Total chrome (Cr) (mg/l)	5
Mercury (Hg) (mg/l)	0.2
Copper (Cu) (mg/l)	2
Nickel (Ni) (mg/l)	5
Zinc (Zn) (mg/l)	10
Tin (Sn) (mg/l)	5
Boron (B) (mg/l)	3
Oil which is come from tar and petroleum (mg/l)	50
Surface active agent	Non-biodegradable Surface active agent discharge is forbidden

To discharge municipal sewerage system, permission that is called sewerage connection permission, was taken from free zone management. For the taking permission, waste water sample was sent to analyze in authorized laboratory. After analysis result, sewerage connection permission was taken from free zone management. To control waste water quality, analysis in authorized laboratory was made once every three months.

There are nine chimneys in the plant (two boiler chimneys, generator chimney, resin aspiration chimney, five aspiration chimneys). Additionally exhaust gases emissions are other sources in the plant. These gas emissions were measured by authorized laboratory annually and controlled according to the periodical measurement.

Monthly natural sources consumption is measured by utilities department and is reported to environmental engineer in key performance indicator table (KPI). When environmental engineer find abnormal situation in the table about natural sources consumption, corrective action is started.

Before an employee start to work in the plant, personal noise measurement is done. To provide workers health and safety, personal noise measurement and environmental noise measurement were done annually. Measurements results were evaluated. According to the evaluation, project that was reduce high noise level, was started to protect workers. Workers also used personal protective equipment.

4.5.6 Environmental Preparedness and Response

In this part of study, emergency situation hand book was prepared and formed. Aim of the handbook was to describe and minimize environmental impacts under emergency situation. Furthermore, another goal was to protect human health during emergency situation.

Emergency situation handbook was formed seven different parts. Parts are given below;

- Part 1 : Index
- Part 2 : Objectives
- Part 3 : Company information
- Part 4 : Emergency situation management
- Part 5 : Emergency situation instructions and reports
- Part 6 : Contacts information
- Part 7 : Appendix

Company information contained company name, location, address, transportation, and road in the plant, parking area, buildings in the plant, employees and working hours.

First of all, emergency situation organization, which is given at Figure 4.4 below, was formed.

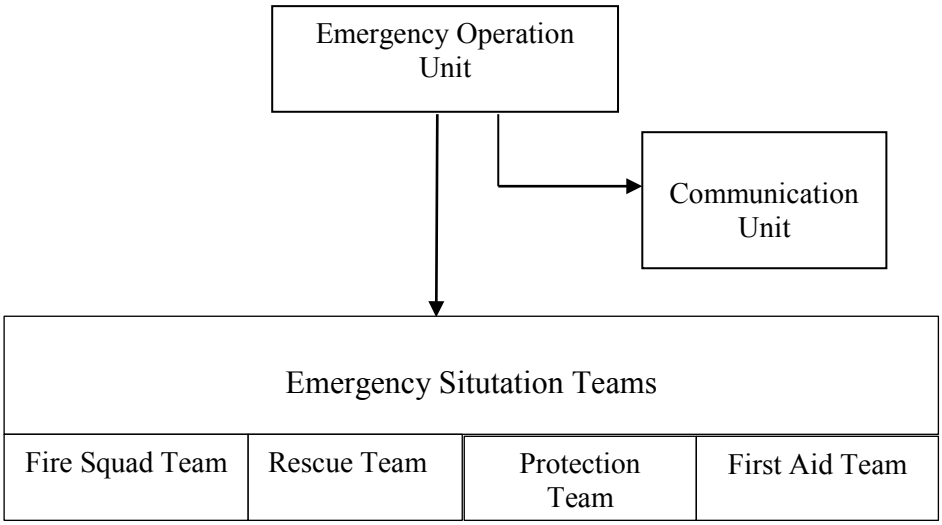

Figure 4.4 Emergency situation organization

Emergency operation unit team, communication unit team, emergency situation teams were established and published. Environmental engineer, safety engineer and utilities manager played an active role at emergency operation unit team. Environmental engineer, safety engineer and human resources department organized emergency situation training and practice. After training and practice, emergency situation teams list were placed at all bulletin boards. The training and practices should be renewed annually. The team list should be updated.

Emergency situation handbook included different kind of emergency situations. There are given below;

- Fire and explosion
- Chemical leakage and spillage
- Natural disasters
- External threats
- Internal events

If fire or explosion occurs, employee who sees fire or explosion should press the fire button and security team member, who heard alarm, should inform emergency operation unit and call out the fire brigade.

After fire alarm, all employees out of emergency operation unit team should evacuate the plant by using emergency ways and doors and everybody should come in to meeting point. Emergency operation team manages the situation and coordinates employees to exit ways.

If fire or explosion is under control, special environmental aspect and impact evaluation is calculated and related corrective action should be done.

If there is chemical leakage or spillage, employee who sees leakage or spillage should inform emergency operation unit team and instructions, which is given below are applied;

- Shut down all electrical equipment's.
- For aspiration, open doors and windows.
- Control chemical with absorbents to prevent diffusion around.
- Absorb chemical in absorbents
- Dispose absorbents to contaminated waste area.

Instructions during natural disaster, external threat and integral events were described in the emergency situation handbook.

4.6 Checking and Corrective Action

4.6.1 Monitoring and Measurement

To manage environmental aspects and impacts, environmental parameters should be measured. To implement EMS at ignition coil production plant, environmental

parameters which are measured periodically were specified in this part of study. These are given below;

- Monthly waste amounts
- Monthly water consumption
- Monthly electrical consumption
- Monthly natural gas consumption
- Monthly raw material consumption
- Monthly production
- Total employees
- Monthly waste water flow
- Emissions
- Noise
- Odour

To enter these environmental parameters, a table was prepared by environmental engineer which was called key performance indicator table (KPI). Monthly KPI table was filled by related department. Departments which were responsible for measuring parameters are given below,

- Monthly waste amounts : Environmental engineer
- Monthly water consumption : Utilities manager
- Monthly electric consumption : Utilities manager
- Monthly natural gas consumption : Utilities manager
- Plant Size : Utilities manager
- Monthly raw material consumption : Production manager
- Monthly produced product : Production manager
- Total employees : Human resources manager
- Monthly working hours : Human resources manager
- Monthly waste water flow : Utilities manager
- Emission : Environmental engineer

- Noise : Environmental engineer
- Odour : Environmental engineer

When KPI table was completed, environmental engineer evaluated KPI results and prepared a special report. If there were any unexpected results, environmental engineer and related department searched for the reasons of these unexpected results and took corrective actions.

In addition to monitor environmental performance and manage environmental system, procedures were prepared. These procedures were chemical warehouse management procedure, waste management and waste area management.

4.6.1.1 Waste Management

4.6.1.1.1 Quantity of Waste. To prepare waste management procedure, at first, types of waste and sources were specified. Quantity of waste is given and evaluated at results section.

4.6.1.1.2 Internal Waste Transfer. After specified waste types and quantity, proper waste boxes were placed to selected areas to segregate waste in its sources. All employees are responsible to segregate waste in its sources and to put waste in the correct waste box. After waste box filled, cleaning personnel carried waste box in waste area and empty box in proper waste containers. Internal waste transfer is summarized at next section.

4.6.1.1.3 Waste Commission in Free Zone. Ignition coil production plant is located in X free zone because of that reason the plant subjects to special official procedure.

Legal requirements are mentioned as “The organization shall ensure that these applicable legal requirements and other requirements to which the organization subscribes are taken into account in establishing, implementing and maintaining its

environmental management system ” (International Organization for Standardization, (2004)).

Referring to statement above plant must follow free zone procedures. Free zone in Turkey is administered by Free Zone Application Regulation (Free Zone Application Regulation issued in Official Journal numbered 21520 and dated March 10, 1993). Definition of free zone is given below.

> An area where its borders are decided by council of ministers with the aim to support investments and production for exports, to increase the rate of direct foreign investments and technology transfer in to the country, to encourage organizations for export trading activities and increase international trade volume (Article 1 of the Free Zone Law, numbered 3218, issued date June 6, 1985 (published in Official Journal numbered 18785 and dated June 15, 1985)).

Therefore this special situation changes waste management and waste transfer, transforms to a different process than other industrial zone.

Waste management in Turkey’s free zone must be accorded article 37 of the Free Zone Application Regulation (Article 37 of the Free Zone Application Regulation issued in Official Journal numbered 21520 and dated March 10, 1993).

X free zone does not have a disposal area which is indicated in Free Zone Applications Regulation (Free Zone Application Regulation issued in Official Journal numbered 21520 and dated March 10, 1993). For that reason waste, which is occurred in ignition coil production plant, was transferred to out of X free zone.

In consideration of Free Zone Applications Regulation (Free Zone Application Regulation issued in Official Journal numbered 21520 and dated March 10, 1993), waste transfer procedure and application in X free zone were defined. The procedure and application are given below;

Waste commission meets twice a month in X free zone. The commission members are custom officer, custom enforcements officer, free zone director officer and an officer from ministry of environment. Waste commission's duty is given below,

- To regulate waste transfer methods,
- To accept applications about waste transfer,
- To evaluate application,
- To approve or deny permission requests for waste transfer.

Environmental representatives, who works in X free zone, prepare official papers for application and apply to the commission. After applications are received, environmental representative participate the commission. When waste commission is held, applications are evaluated and permissions are approved or denied by waste commission. For ignition coil production plant, environmental engineer manages this process.

Officer of Environmental Ministry evaluates applications from the point of public environmental legislations. Custom officer evaluates applications within the scope of custom legislations.

If an application is approved by each commission member, permission is approved for waste transfer.

Environmental representatives apply to the commission with requested official document. These documents are given below,

- Waste owner company's circular signatures
- Waste transfer company's circular signature
- Waste form which is filled by waste owner
- For waste transfer company environmental permit/license is issued by ministry of environment.

4.6.1.1.4 Waste Transfer Organization. After environmental representative take necessary permission from waste commission in X free zone, waste transfer is organized.

Environmental engineer controlled waste area daily. When storage capacity of a waste was exceeded, the waste transfer was organized. Environmental engineer had to control waste company's documents. Before waste transfer, documents were asked from waste transfer company are described below.

To transfer hazardous waste, requested documents are given below;

- Waste transfer company's applications to custom for waste transfer
- Transport license of hazardous waste for vehicle
- Transport license of hazardous waste for driver

To transfer non-hazardous waste, necessary documents is given below;

- Waste transfer company's applications to custom for waste transfer
- Information about vehicle and driver

After all requested documents are collected, an application is filled to custom. After custom confirmation, waste transfer is started.

4.6.2 Non Conformance & Corrective & Preventive Actions

If non conformities occurred, corrective action form is filled and corrective actions are taken. If there are potential non conformities, preventive action form is filled and preventive actions are taken.

To find non conformities and managing the process is one of the environmental representative responsibilities. During monthly internal audit, environmental

representative should find non conformities but nonconformities can be found by customers, suppliers, workers, neighbors, visitors etc.

In this part of study, corrective action and preventive action forms were prepared and formed.

Table 4.4 Corrective action form of the plant

Corrective action Form		
1	Non comformity Explanation Date Location Person who reports	
2	Root causes of non comformity Date Person who analyses root causes	
3	Planned corrective action Deadline corrective action	
4	Result Date	

Table 4.5 Preventive action form of the plant

Preventive action Form		
1	Potential non comformity Explanation Date Location Person who reports	
2	Planned preventive action Deadline preventive action	
3	Result Date	

When nonconformity is determined by customers, suppliers, neighbors etc., it is transmitted to related department, where present nonconformities are converted to corrective actions by related departments with filling 1, 2 and 3 parts in corrective action form. Corrective action form which is shown in Table 4.4 is transmitted to environmental representative. Environmental representative follows the accomplishment of corrective actions.

If an employee find nonconformities, employee fill part I of the corrective action form and give the form to their manager. Manager who takes the corrective action form makes root-cause analyzes and writes planned precautions.

Preventive actions are started for potential nonconformities. Potential nonconformity sources are filled by person who determines potential nonconformities in preventive action form which is shown in Table 4.5 Then

preventive action form is given to environmental representative. Environmental representative follows the accomplishment of preventive actions.

Action monitoring is explained as “Preventive/corrective action forms are numbered according to starting date by environmental representative who makes statistical analyzes about preventive/corrective actions” (Pişkinöz, 2008).

4.6.3 Records

The plant uses special software to keep records. EMS records are loaded to software by responsible employee and records are followed in the software. On the other hand, original EMS records, which include wet signature, are kept in archive room.

To continue EMS, records about EMS must be kept and protected. At the present situation, EMS records are not systematically archived in the plant because of undefined responsibilities.

In this part of study, responsible employee that keeps the records loads the records to software that was defined. The responsible employee list is given at Table 4.6 below.

Table 4.6 Responsible of keeping records list of the plant

No	Record	Responsible	Retention Period
1	Legal requirements and other requirements table	Environmental Representative	5 years
2	Permission which is given by free zone	Environmental Representative	5 years
3	Permission which is related with environment	Environmental Representative	Until validation time
4	Environmental aspect and impact evaluation form	Environmental Representative	5 years
5	Environmental training forms	Human Resources Department	3 years
6	Environmental training plan	Human Resources Department	3 years
7	Nonconformance form	Environmental Representative	3 years
8	Corrective and preventive action forms	Environmental Representative	5 years
9	External waste transfer forms	Environmental Representative	5 years
10	Internal audit forms	Environmental Representative	5years
11	External audit records	Environmental Representative	10 years
12	Management review records	Environmental Representative	3 years
13	Emergency plan	Health and Safety Engineer	3 years
14	EMS meeting results	Environmental Representative	3 years
15	Reports of environmental accident	Environmental Representative	10 years
16	Contract with waste company	Environmental Representative	5 years
17	Material safety data sheets	Health and Safety Engineer	10 years
18	Machines acceptance forms	Production Manager	3 years
19	Machine maintenances records	Maintenance Manager	3 years
20	Internal and external communication about ems	Environmental Representative	5 years
21	Periodical measurements and analyzes	Environmental Representative	10 years
22	Procedures which are related ems	Environmental Representative	3 years
23	Environmental policy	Environmental Representative	5 years
24	Environmental objectives and targets	Environmental Representative	5 years

4.6.4 Environmental Management System Audit

To control assuring of conformation EMS, internal and external audits should be applied. In this part of study, internal audit procedure and system for the plant were prepared and formed.

Firstly, tasks for internal audit system was defined and given to responsible persons. The tasks is given below,

- Environmental representative should make annual internal audit plan, apply audit, report audit results, and follow corrective and preventive actions.
- Environmental committee meeting should follow corrective and preventive action.
- Department manager should participate audits and support to apply audit in their department.
- Environmental representative and safety engineer should make audits together. However, safety engineer has to take environmental audit training which is called internal auditor training.

Annual internal audit plan was formed. It included audit date, audit time, shift which audit is made, area where audit is made and auditors. After annual internal audit plan was formed, it was published.

If new development, environmental accidents and new environmental impacts occur, internal audit should be reviewed as soon as possible.

Internal audit check list was prepared and the check list has been contained four main title which are given below,

- Environment
- Emergency
- Safety

- Working environment

Questions which are in internal audit check list are given below.

➢ Environment

1. Do employees know the Integrated Quality Policy? Do they know how to access?

2. Are employees aware of their probable effects on environment? (Cross check from the environmental aspect and impact list)

3. Do employees know what should be done when an environmental accident happens? Who will be informed? How will the side effects eliminated? Is there an instruction about preventing contamination when spillage and/or leakage take place?

4. Do employees have training records including 'Environmental Aspects and impacts of their Job, 14001 Awareness, and Emergency Plan?

5. Do contractors have training records including 'Environmental Aspects and impacts of their Job, 14001 Awareness, and Emergency Plan?

6. Check whether chemicals are stored safely against spillage/leakage? Are there plates under drums and are they big enough to hold all the chemicals inside? Is there any definition of maximum storage amount?

7. Check whether there are open manholes in an area that has risk of chemical spillage and/or leakage?

8. Are proper waste containers available on line? Check whether all waste containers are labeled and used accordingly.

9. Is the suitable protection for carcinogenic substances made? (Proper personal protective equipment, measurement systems, storage at minimum amount)

10. Check the waste area: Are there waste disposition instructions are they applied? Are labels appropriate to waste type? Are related responsibilities defined?

11. Is the suitable protection for explosive substances made?

12. Are the pressured tubes stored at adequate conditions? (Protected for electrostatic loading, proper storage, definition of maximum storage)

- Emergency situation

1. Did employees participate to any Emergency trials?
2. Do employees know what to do in case of an emergency?
3. Are there employees trained for First Aid and Emergency and are they available for all shifts?
4. In case of first aid or emergency, do employees know who is to be contacted?
5. Is medical equipment available for first aid?
6. Are emergency exits indicated properly?
7. Do emergency doors open to outside? Do they labeled and durable?
8. Do employees know where emergency exits and fire extinguishers are located?
9. Are emergency exit doors and ways clear from obstacles?
10. Are the tools for fire and emergency suitable and durable? (Fire extinguishers, eye-body washers)
11. Are fire extinguishers available at stated location? Are they controlled periodically? Are they easily accessible?

- Safety

1. Are operators prevented to access dangerous areas of the production process? (10 points) if not, is there any automatic system to shut machine down in case of emergency or incorrect operation by the operator? (10 points) if not, is it easy for the operator understanding if the machine is operating or not? (5 points)
2. Are cable, switches and other electrical components in good conditions (electrical insulation, cables in channel, grounding)?
3. Are electrical panel boards at suitable conditions? (Durable, correct position, label, locked, buttons)
4. Do the electrical hand tools fit the purpose and stored at safety position?
5. Have footswitches of machines safeguard?
6. Does emergency button of machines work?
7. Are moving parts of machine protected safely? If yes, are the safeguards durable? Does the machine stop when the safeguards covers open?

8. Are there any sharp edges?

9. Is the location of machine and materials proper and safe?

10. Does work instruction include information about safety of operation? Are they easily understandable?

11. Is there any safety instruction? If yes, are these instructions correct? Are safety instructions followed by employees?

12. Do employees use their PPEs properly? (Storage conditions, fit the purpose, clean)

13. Do forklift drivers have forklift driving license?

14. Do the forklift's lamps and signs work?

15. Are chemicals used known by employees (risk, MSDS, etc.)? Are related MSDS documents easily accessible?

16. Are walking ways indicated and suitable? (smooth, dry, clean, signed where necessary)Is the transition distance 80cm?

17. Are the doors and entrances suitable? (Push - Pull labels)

18. Are stairs clean and tidy? Are there handles and anti-slipping stripes?

19. Are line warehouses tidy and free from risks? (Shelves durable, definition of max. storage amount, protection of console)

20. Are the machines for transportation selected suitable?

21. Are the staircase and steps suitable? (Width $\geq$ 22 cm, Height $\leq$ 26 cm)

22. Are platforms stable and in good conditions?

23. Are ladders suitable? (Width $\geq$ 55 cm, angle of gradient : 60, protection for stair foots)

24. Are barriers available for platforms higher than 1.2 m?

25. Are gas tanks located safely?

26. Are chemicals stocked safely? (away from heat, electricity sources, definition of max. amount)

27. Are there safety labels, locks, barriers for maintenance or repair operations?

28. Are chemicals correctly labeled (as flammable, toxic, etc.)

29. Are the protections for works on opening areas adequate? (Traffic rules in plant)

30. Have the windows suitable conditions? (Clean, durable, opening-closing tools safely)

31. Do the places clean? (Windows, resting places, dressing rooms, dining hall, kitchen, toilets and bash basins)

32. Have drinking water and water dispenser's suitable conditions? (Clean, hygienic, labeled)

33. Have battery charging room suitable conditions? (Adequate aspiration, suitable grounding, distance to flammable substances ≥ 2.5 m

- Work Environment

1. Are humidity and temperature monitored and adequate? (resin area)

2. Is ventilation adequate?

3. Is aspiration system for emissions, solvent vapors and soldering smoke adequate?

4. Is there any biological test and periodical maintenance for ventilation system?

5. Are noise measurement results appropriate? If not, are appropriate measures taken?

6. Is violence of lighting adequate (especially in visual control areas)?

7. Are the cables of lamps and lamps suitable? (Protector of lamps available, durable) (Cables are tidy)

8. Are appropriate measures and precautions taken for hot/cold surfaces? (Label)

9. Is work environment clean and tidy? (check for liquid leaks)

Questions have four answers which are conformance, non-conformance, improvable, and not applicable.

1. If answer is confirmative, there do not need any actions.

2. If answer is non-conformance, it means there is major non-conformance and non-conformance form should be filled, the form should be given to related department. Related department manager should filled new corrective action form and start corrective action. The new corrective action should be followed by

environmental representative. After corrective action is completed, non-conformance form is closed.

3. If answer is improvable, there is minor non-conformance and corrective or preventive action form should be filled, the form should be given to related department. Related department manager should filled new corrective or preventive action form and start action. The new corrective or preventive action should be followed by environmental representative.

4. If answer is not applicable, the question is not suitable for the area.

For external audit, external auditing company was found and agreed. Once a year external ems audit was made by the company. Environmental representative manage external audit process.

4.7 Management Review

For top management, management review meeting was planned and organized in this part of study. The meeting members were defined as environmental representative, EMS meeting committee and top manager.

Management review meeting was planned to hold periodically once a year. Environmental representative prepared a presentation. The presentation should contain titles which are given below,

- Internal and external audit results
- Non-conformances, corrective/preventive actions
- Important environmental aspect/impact
- Environmental management program
- Changed or new environmental regulations
- Recent developments (machine, process, building)
- Environmental accidents

CHAPTER FIVE
RESULTS

At this section, result of applications which are defined and applied at previous section, are given and evaluated.

As indicated in the methodology, in order to define the plant's environmental aspects and impacts, environmental aspects and impacts evaluation form has to be prepared and environmental aspect and impacts evaluations have to be calculated for each environmental aspect. Therefore, environmental aspect and impact evaluation study has been applied all area in the plant. The list of the environmental aspects and impact evaluations of plastic production line, ignition coil production line and offices are shown at Table 5.1, 5.2 and 5.3.

When Table 5.1 was reviewed, there was not any score bigger than 70, so preparing immediate action was not needed. But at Table 5.1, there were two scores which were between 50-70, for that reason medium-term action plan should have been prepared. First score, which was needed to define medium-term action, was 64 that resulted by raw material packaging and its impact was non-hazardous waste (waste cardboard). Score is calculated below,

$$\text{Score} = P1xP2xP3xP4xP5 \qquad (5.1)$$
$$\text{Score} = 2x2x4x1x4 = 64$$

P1 equals to 2 because there was legal obligations about related impact (non-hazardous waste) and related impact is applicable to the legal obligations. P2 equals to 2 because environmental impact affected one area (soil). P3 equals to 4 because impact frequency was once a day. P4 equals to 1 because there was no probability of an emergency situation. P5 equals to 4 because there was consumption of natural sources.

Other score which was needed to define medium-term action, was 64 at Table 5.1 resulted by line of work and its impact was natural sources consumption (electrical energy). Score is calculated below,

$$\text{Score} = P1xP2xP3xP4xP5 \quad (5.2)$$
$$\text{Score} = 2x2x4x1x4 = 64$$

P1 equals to 2 because there was legal obligations about related impact and related impact was applicable to the legal obligations. P2 equals to 2 because environmental impact affected one area. P3 equals 4 because impact occurred once a day. P4 equals 1 because there was no probability to occur an emergency situation. P5 equals 4 because there was consumption of natural sources.

When Table 5.2 was reviewed, there was not any score bigger than 70, so that preparing immediate action was not necessary for ignition coil production line. But at Table 5.2, there were two scores which were between 50-70, that reason medium-term action plan should have been prepared. These scores impacts were waste packing and electrical consumption like Table 5.1. Therefore, calculation of score was the same as above.

When Table 5.3 was reviewed, there was not any score bigger than 70, so that preparing immediate action was not necessary for ignition coil production line. But at Table 5.3, there were two score which were between 50-70, that reason medium-term action plan should have been prepared. First score which was needed to defined medium-term action was also 64 at Tale 5.3. The score resulted by line of work and its impact was natural sources consumption (electrical energy). Calculation of electrical energy consumption is given above. Other score, which was needed to defined medium-term action, was 64 that resulted by consumption of paper and its impact was non-hazardous waste (waste paper). Calculation about waste paper is given below,

$$\text{Score} = P1xP2xP3xP4xP5 \quad (5.3)$$
$$\text{Score} = 2x2x4x1x4 = 64$$

P1 equals 2 because there were legal obligations about related impact (non-hazardous waste) and related impact is suitable to the legal obligations. P2 equals 2 because environmental impact affected one area (soil). P3 equals 4 because impact occurred once a day. P4 equals 1 because there was no probability to occur an emergency situation. P5 equals 4 because there was consumption of natural sources.

For these score, which were between 50-70, medium-term action plan was prepared. The plan is shown below at Table 5.4. To decrease natural sources consumption, a research of energy saving study was started. For non-hazardous waste (waste paper and waste cardboard), separation of waste at source was started and separated waste was recycled by recycling company.

Table 5.1 The environmental aspect and impact evaluation form for plastic production line

No	Aspect	Impact	Source	P1	P2		P3	P4	P5	Score	Normal	Abnormal	Emergency
1	Plastic raw material usage	Non-hazardous waste (Waste Plastic)	Production	2	s	2	4	1	1	16	X		
2	Metal usage	Non-hazardous waste (Metal Scrap)	Production	2	-	1	4	1	1	8	X		
3	Chemical Leakage	Hazardous waste (Contaminated waste)	Production	2	a,s	4	3	1	1	24	X		
4	Contaminated personal protective equipment	Hazardous waste (Contaminated waste)	Production	2	a,s	4	3	1	1	24	X		
5	Injection machine maintanance	Hazardous waste (Waste Oil)	Maintanance	2	s	2	3	1	1	12	X		
6	Chemical spillage (Alcohol Spillage)	Chemical Impact	Production	2	a	2	2	1	1	8	X		
7	Raw material packaging	Non-hazardous waste (Waste packaging)	Production	2	s	2	4	1	4	64	X		
8	Accumulator changing	Hazardous waste (Waste Accumulator)	Maintanance	2	s	2	2	1	1	8	X		
9	Water consumption for injection machine	Natural Source Consumption (Water consumption)	Production	2	w	2	2	1	4	32	X		
10	Process line	Emission	Production	2	a	2	4	1	1	16	X		
11	Process line	Natural Source Consumption (Electrical energy consumption)	Production	2	a	2	4	1	4	64	X		
12	Process line	Noise	Production	2	h	2	4	1	1	16	X		

Table 5.2 The environmental aspect and impact evaluation form for ignition coil production line

No	Aspect	Impact	Source	P1	P2		P3	P4	P5	Score	Normal	Abnormal	Emergency
1	Plastic raw material usage	Non-hazardous waste (Waste Plastic)	Production	2	s	2	4	1	1	16	X		
2	Metal usage	Non-hazardous waste (Metal Scrap)	Production	2	-	1	4	1	1	8	X		
3	Copper Wire Usage	Non-hazardous waste (Copper Wire)	Production	2	-	1	4	1	1	8	X		
4	Manufacturing defect	Hazardous Waste (Electronic Scrap)	Production	2	-	1	4	1	1	8	X		
5	Soldore Wire Usage	Hazardous Waste (Solder Wire Scrap)	Production	2	-	1	2	1	1	4	X		
6	Resin and Hardener Usage	Hazardous Waste (Waste Resin and Hardener)	Production	2	s	2	4	1	1	16	X		
7	Resin Usage	Non-hazardous Waste (Waste Solid Resin)	Production	2	s	2	4	1	1	16	X		
8	Raw material consumption	Hazardous Waste (Contaminated Empty Drum)	Production	2	-	1	4	1	1	8	X		
9	Maintanence of Line	Hazardous Waste (Waste Solvent)	Production	2	s	2	3	1	1	12	X		
10	Chemical Leakage	Hazardous waste (Contaminated waste)	Production	2	a,s	4	3	1	1	24	X		
11	Contaminated personal protective equipment	Hazardous waste (Contaminated waste)	Production	2	a,s	4	3	1	1	24	X		
12	Injection machine maintanance	Hazardous waste (Waste Oil)	Maintanance	2	s	2	3	1	1	12	X		

Table 5.2 The environmental aspect and impact evaluation form for ignition coil production line, continue

No	Aspect	Impact	Source	P1	P2		P3	P4	P5	Score	Normal	Abnormal	Emergency
13	Chemical Spillage (Alcohol Spillage)	Chemical Impact	Production	2	a	2	2	1	1	8	X		
14	Raw material packaging	Non-hazardous Waste (Waste packaging)	Production	2	s	2	4	1	4	64	X		
15	Accumulator changing	Hazardous Waste (Waste Accumulator)	Maintanance	2	s	2	2	1	1	8	X		
16	Chemical Usage	Hazardous Waste (Contaminated Packing)	Production	2	s	2	4	1	1	16	X		
17	Raw Material Usage	Non-hazardous Waste (Wooden pallet)	Production	2	a	2	4	1	1	8	X		
18	Process line	Emission	Production	2	a	2	4	1	1	16	X		
19	Process line	Natural Source Consumption (Electrical energy consumption)	Production	2	a	2	4	1	4	64	X		
20	Process line	Noise	Production	2	h	2	4	1	1	16	X		
21													
22													
23													
24													

Table 5.3 The environmental aspect and impact evaluation form for offices

No	Aspect	Impact	Source	P1	P2		P3	P4	P5	Score	Normal	Abnormal	Emergency
1	Consumption of Paper	Non-hazardous Waste (Waste Paper)	Offices	2	s	2	4	1	4	64	X		
2	Catridge Usage	Hazarous Waste (Waste catridge)	Offices	2	-	1	3	1	1	6	X		
3	Battery Usage	Hazardous Waste (Waste Battery)	Offices	2	-	1	3	1	1	6	X		
4	Working in Office	Natural Source Consumption (Electrical enegry Consumption)	Offices	2	a	2	4	1	4	64	X		
5	Working in Office	Noise	Offices	2	h	2	4	1	1	16	X		
6													
7													
8													
9													
10													
11													
12													

Table 5.4 Medium-term action plan for environmental aspects and impacts

No	Aspect	Impact	Evaluation Score	Action Type	Action	Deadline
1	Raw Material Packaging	Non-hazardous waste (Waste Cardboard)	64	Medium-term	To separate waste at sources and to recycle cardboard	4 months
2	Line of work	Natural sources consumption	64	Medium-term	To research energy saving methods for line	4 months
3	Consumption of paper	Non-hazardous waste (Waste Paper)	64	Medium-term	To separate waste at sources and to recycle paper	4 months

After definition and evaluation environmental aspects and impacts, to monitor environmental performance, environmental parameters which should have been measured, have already been defined at previous section. As a result of this study, environmental parameters that should be measured during the operation to define the environmental performance were defined and a table (i.e. KPI table) including measurement frequency and objectives was formed. Summary table about KPI is given at Table 5.5 below.

Table 5.5 Environmental parameters measured to define the environmental performance

Environmental Parameters	**Measurement Frequency**	**Objective**
Solid Waste Amount	Monthly	To calculate solid waste amount for each producing unit
Hazardous Waste Amount	Monthly	To calculate hazardous waste amount per for each producing unit
Medical Waste Amount	Monthly	To calculate medical waste amount for each employee
Water Consumption	Monthly	To calculate water consumption per working hour
Electrical Consumption	Monthly	To calculate electrical consumption for each producing unit
Natural Gas Consumption	Monthly	To calculate natural gas consumption per plant size
Raw Material Consumption	Monthly	To calculate raw material consumption for each producing unit
Total Produced Parts	Monthly	To calculate waste quantity, electrical consumption for each producing unit
Total Employees	Monthly	To calculate water consumption, natural gas consumption, waste water flow for each employee
Working Hours	Monthly	To calculate water consumption per working hour
Plant Size	With expansion	To calculate natural gas consumption per plant size
Waste Water Flow	Monthly	To calculate waste water flow for each employee
Emissions	Annually	To evaluate environmental impact
Noise	Momentary	To protect employee's health and safety
Odour	If need	To protect employee's health and safety

Environmental parameter changes are monitored based on to the variables which parameter is depended to. For example solid waste amount depends on total producing unit therefore solid waste amount is evaluated for each producing unit and medical waste amount depends on total employee therefore medical waste was evaluated for each employee.

Following to definition of environmental impacts, in order to realize the objectives and targets which are defined at previous chapter, an environmental management program was formed and schedule that was presented in the program was followed up to implement EMS in the plant. The environmental management plant of the ignition coil production plant is given at Table 5.6.

Table 5.6 Environmental management program of ignition coil production plant

No	Objective	Target	Responsible	Action	Result	Deadline
1	To manage of solid waste	To provide the separate collection of all the solid wastes in its source.	Environmental Engineer	To buy containers for all kinds of wastes and to place in necessary areas.	Done	3 months
		To provide %10 increase of recycling ratio		To search waste which can be recycled at the plant and to search recycling company?	Done	6 months
		To improve internal waste transfer		To plan and to start to phase in internal waste transfer system	Done	5 months
2	To manage of waste water	To keep under control wastewater analyzes.	Environmental Engineer	To buy new sampling set and to follow up analyses	Done	2 months
3	To manage waste area and chemical warehouse	To build up new waste area and to improve storage conditions in chemical materials warehouse.	Environmental Engineer & Utilities Manager	To search consulting company for building project and to start project	Done	6 months
					Done	4 months
4	To train employees about environmental consciousness	To organize training about environmental consciousness for newcomers	Environmental Engineer & Human Resource Manager	To prepare training program and to train newcomers.	Done	6 months
		To organize special training for all special positions.		To prepare special training and to train all special positions.		

5.1 Realization of the Objective 1: Management of Solid Wastes

To realize the first objective which is to manage to solid waste, separating solid waste their in sources and organizing internal waste transfer have been completed. To separate solid waste in its source, types of waste and waste quantity were determined as first. The summary of the data are presented in Table 5.7. and also depicted at Figure 5.1, 5.2, 5.3, 5.4 and 5.5.

Table 5.7 shows that domestic waste, which was sourced at dining hall and toilets, had greatest amount compare to other waste at 2011. The collected amount is proportional to number of employee. Additionally plastic waste had second greatest amount after domestic waste at 2011. On the other hand, Figure 5.2 shows that, it had greatest amount compare to other waste which was sourced from production at 2011.

Hazardous waste ratio and non-hazardous waste ratio are shown at Figure 5.5. Hazardous waste ratio was 18 % and non-hazardous waste ratio was 82 % during 2011.

Table 5.7 Quantity of waste from the plant during 2011

Waste	Type	Quantity (kg)	Quantity Percentage
Waste plastic	Non-hazardous	229160	14.8058 %
Metal Scrap	Non-hazardous	107800	6.9648 %
Copper Wire Scrap	Non-hazardous	118206	7.6372 %
Electronic Scrap	Hazardous	91960	5.9414 %
Solder Wire scrap	Hazardous	0	0.0000 %
Waste Resin and Hardener (Liquid)	Hazardous	8420	0.5440 %
Waste Solvent	Hazardous	14280	0.9226 %
Waste resin (Solid)	Non-hazardous	35850	2.3162 %
Contaminated empty drum	Hazardous	130440	8.4276 %
Waste Oil	Hazardous	2680	0.1732 %
Contaminated Waste	Hazardous	19880	1.2844 %
Contaminated Packaging	Hazardous	6350	0.4103 %
Waste Packaging and paper	Non-hazardous	120000	7.7531 %
Wooden Pallet	Non-hazardous	180000	11.6296 %
Waste fluorescence	Hazardous	160	0.0103 %
Waste batteries	Hazardous	5	0.0003 %
Waste accumulator	Hazardous	4080	0.2636 %
Waste cartridge	Hazardous	480	0.0310 %
Domestic waste	Non-hazardous	478000	30.8830 %
Medical Waste	Hazardous	24	0.0016 %

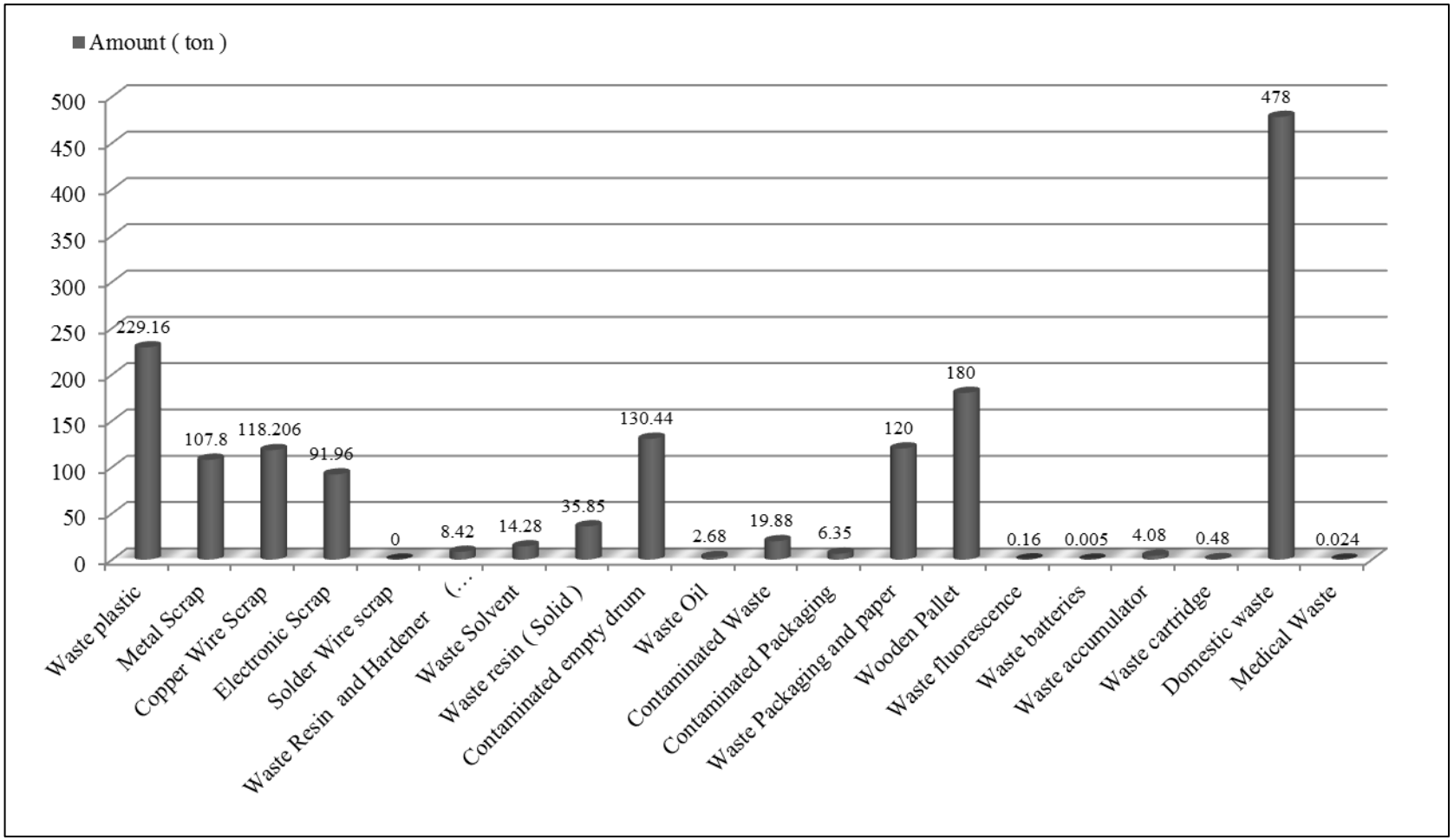

Figure 5.1 Quantity of waste from the plant during 2011

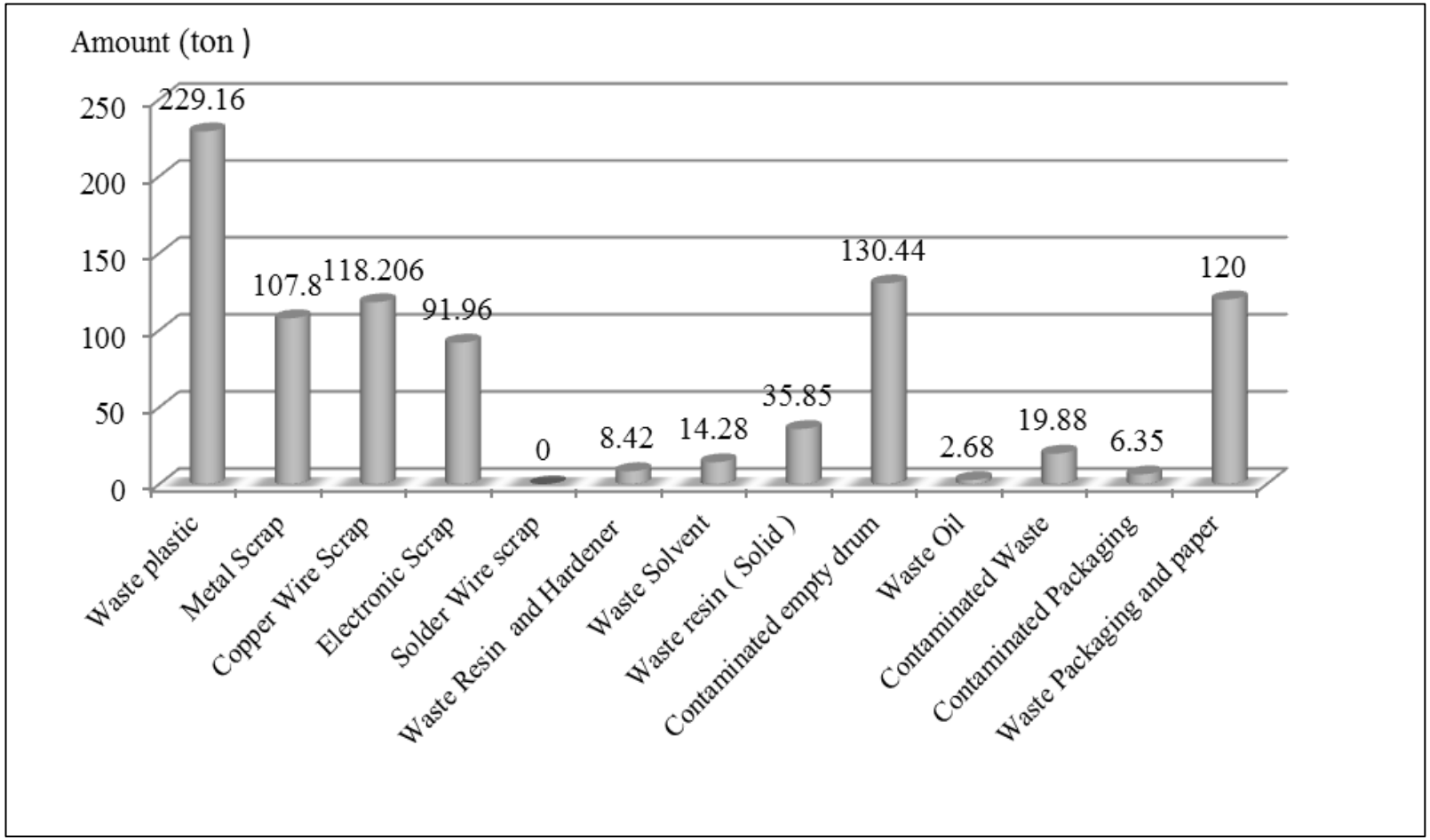

Figure 5.2 Quantity of waste from production during 2011

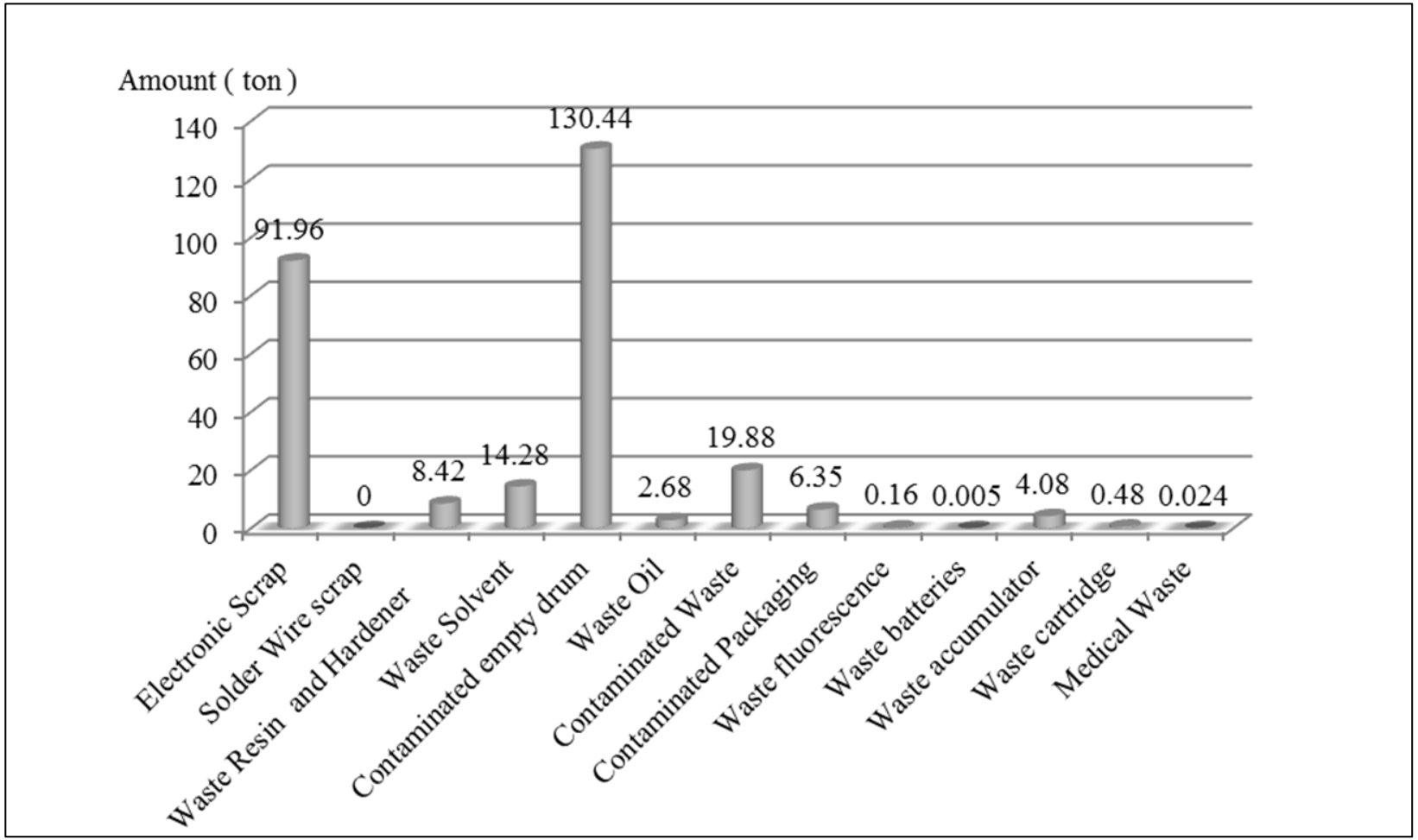

Figure 5.3 Quantity of hazardous waste from production during 2011

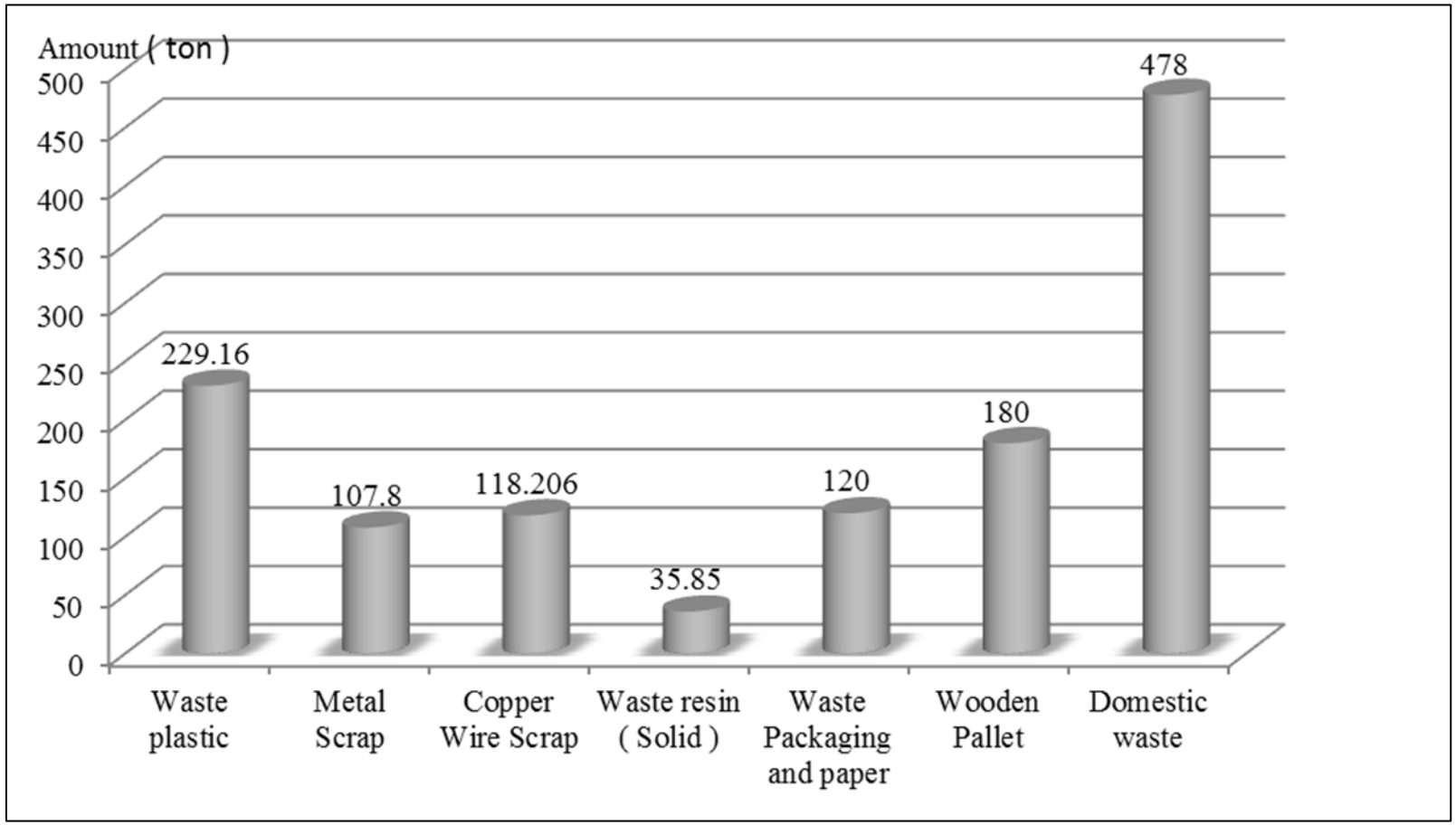

Figure 5.4 Quantity of non-hazardous waste from production during 2011

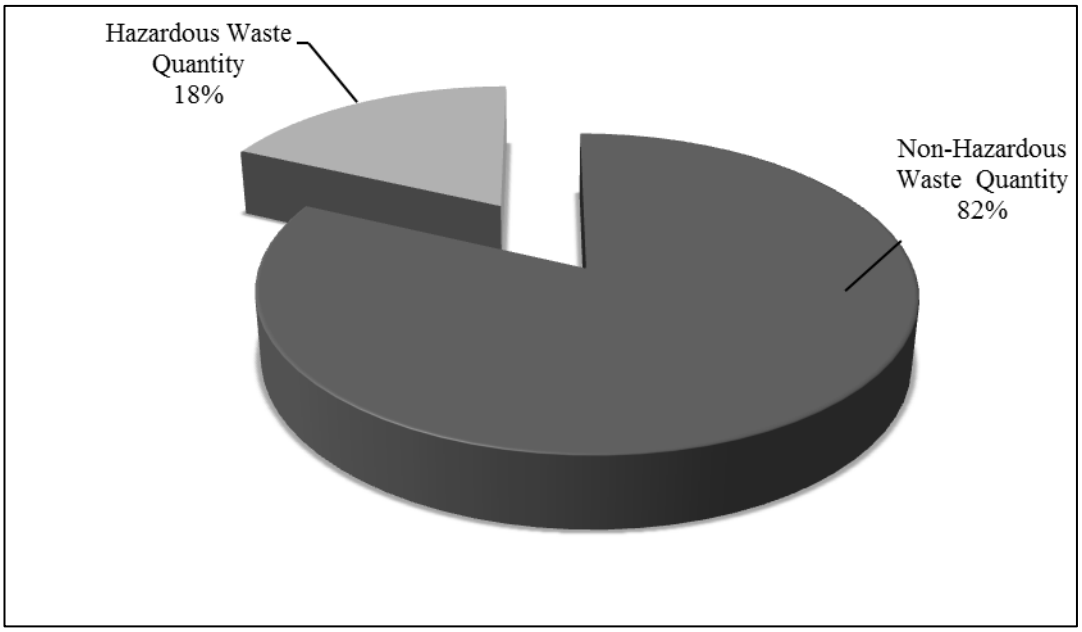

Figure 5.5 Hazardous and non-hazardous waste ratio during 2011

Before this study, waste separation at source had not been applied well in the plant. For example, certain recyclable wastes e.g. waste plastic, waste resin and hardener, waste solvent, waste packaging materials, etc. were disposed off instead of recycling. With the start of waste separation at source, as results of this study, the waste mentioned above were recycled by recycling company (see Table 5.8). According to the data given in Table 5.8 and Table 5.9, waste plastic, waste liquid resin and hardener, waste solvent, waste oil, waste packaging and paper were started to recycle and thus approximately 1000 tons waste per year could be recycled. By this way, recycling ratio was increased from 48% to 65%, and second target of the program was realized.

Table 5.8 Data regarding to recycled waste in the plant

Waste	Type	Quantity (kg)	If this study has been applied	After this study
Waste plastic	Non-hazardous	229160	**Disposal**	**Recycle**
Metal Scrap	Non-hazardous	107800	**Recycle**	**Recycle**
Copper Wire Scrap	Non-hazardous	118206	**Recycle**	**Recycle**
Electronic Scrap	Hazardous	91960	**Recycle**	**Recycle**
Solder Wire scrap	Hazardous	0	**Recycle**	**Recycle**
Waste Resin and Hardener (Liquid)	Hazardous	8420	**Disposal**	**Recycle**
Waste Solvent	Hazardous	14280	**Disposal**	**Recycle**
Waste resin (Solid)	Non-hazardous	35850	**Disposal**	**Disposal**
Contaminated empty drum	Hazardous	130440	**Recycle**	**Recycle**
Waste Oil	Hazardous	2680	**Disposal**	**Recycle**
Contaminated Waste	Hazardous	19880	**Disposal**	**Disposal**
Contaminated Packaging	Hazardous	6350	**Disposal**	**Disposal**
Waste Packaging and paper	Non-hazardous	120000	**Disposal**	**Recycle**
Wooden Pallet	Non-hazardous	180000	**Recycle**	**Recycle**
Waste fluorescence	Hazardous	160	**Disposal**	**Disposal**
Waste batteries	Hazardous	5	**Recycle**	**Recycle**
Waste accumulator	Hazardous	4080	**Disposal**	**Disposal**
Waste cartridge	Hazardous	480	**Recycle**	**Recycle**
Domestic waste	Non-hazardous	478000	**Disposal**	**Disposal**
Medical Waste	Hazardous	24	**Disposal**	**Disposal**

Table 5.9 Evaluation of waste recycling with 2011's data

Data from 2011	Before the study	After the study
Total Waste Amount (ton)	1547.775	1547.775
Recycled Waste Amoun (ton)	748.891	1003.431
Recycle Ratio (%)	48.39	64.83
Increase at Recycle Ratio (%)	**16.45**	

Environmental impacts were decreased after this study for the waste, which were waste plastic, waste resin and hardener, waste solvent, waste oil, waste packaging and paper. Environmental impact of the waste that was disposed before this study was reduced by recycling. The reduction at environmental impacts is shown at Table 5.10.

Table 5.10 Results of environmental impact reducing evaluation

No	Aspect	Impact	Evaluation	Source	P1	P2		P3	P4	P5	Score	Normal	Abnormal	Emergency
1	Plastic raw material usage	Non-hazardous waste (Waste Plastic)	Before this study	Production	2	s	2	4	1	1	16	X		
2			After this study	Production	2	-	1	4	1	1	8	X		
3	Resin and Hardener Usage	Hazardous Waste (Waste Resin and Hardener)	Before this study	Production	2	s	2	4	1	1	16	X		
4			After this study	Production	2	-	1	4	1	1	8	X		
5	Maintanence of Line	Hazardous Waste (Waste Solvent)	Before this study	Production	2	s	2	3	1	1	12	X		
6			After this study	Production	2	-	1	3	1	1	6	X		
7	Injection machine maintanance	Hazardous waste (Waste Oil)	Before this study	Maintanance	2	s	2	3	1	1	12	X		
8			After this study	Maintanance	2	-	1	3	1	1	6	X		
9	Raw material packaging	Non-hazardous Waste (Waste packaging)	Before this study	Production	2	s	2	4	1	4	64	X		
10			After this study	Production	2	-	1	4	1	4	32	X		

After types of waste quantity were determined, suitable waste containers were placed at suitable area that is waste sources. Waste containers were selected based on waste properties. Container properties are presented in Table 5.11. For example, waste solvent container is selected as metal structured, capped, locked, fire proof, leak-proof, corrosion resistant and shake proof.

Table 5.11 Waste container specification for all kind of waste in the plant

Waste	Type	Containers materials			Containers Specifications					
		Plastic	Metal	Cardboard	Covered	Lockbox	Leakproof	Fireproof	Shakeproof	High corrosion resitance
Waste plastic	Non-hazardous	•								
Metal Scrap	Non-hazardous		•		•	•				
Copper Wire Scrap	Non-hazardous		•		•	•				
Electronic Scrap	Hazardous		•		•	•				
Solder Wire scrap	Hazardous		•		•	•				
Waste Resin and Hardener (Liquid)	Hazardous		•		•	•	•	•	•	•
Waste Solvent	Hazardous		•		•	•	•	•	•	•
Waste resin (Solid)	Non-hazardous	•			•					
Contaminated empty drum	Hazardous		•		•		•	•		•
Waste Oil	Hazardous		•		•		•	•		
Contaminated Waste	Hazardous		•		•		•	•		•
Contaminated Packaging	Hazardous		•		•		•	•		•
Waste Packaging and paper	Non-hazardous			•						
Wooden Pallet	Non-hazardous									
Waste fluorescence	Hazardous		•		•		•	•		
Waste batteries	Hazardous	•			•		•			
Waste accumulator	Hazardous		•		•	•	•	•		•
Waste cartridge	Hazardous	•			•		•			
Domestic waste	Non-hazardous	•			•		•			
Medical Waste	Hazardous	•			•		•			

Following to solid waste separation in its source, internal waste transfer has been organized. Responsible personnel from transfer operations have been defined. Internal waste transfer table for offices and production line 101 is given below at Table 5.12 and Table 5.13.

Table 5.12 Internal waste transfer for line 101

Source	Source Location	Waste	Container Type/Number	Responsible of transfer	Transfer frequency
Production	Line 101	Domestic	Domestic waste/14	Cleaning Per.4-11-15	Twice a day
		Contaminated	Contaminated box/2	Cleaning Per.4-11-15	Twice a day
		Cardboard	Box/2	Cleaning Per.4-11-15	Twice a day
		Welding electrode	Scrap box/3	Service operator	Once a week
		Solder	Scrap box/2	Service operator	Twice a day
		Empty Drum	Pallet/2	Line operator	One a day
		Solvent	Solvent box/2	Service operator	Once a week
		Electronic	Scrap box/1	Service operator	Twice a week
		Plastic	Plastic box/1	Service operator	Twice a week

Table 5.13 Internal waste transfer for offices

Source	Source Location	Waste	Container Type/Number	Responsible of transfer	Transfer frequency
Offices	Offices	Domestic	Domestic box/13	Cleaning Per.2-10-14	Twice a day
		Paper	Waste paper box/1	Cleaning Per.2-10-14	Once a week
		Domestic	Domestic box/2	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/5	Cleaning Per.2-10-14	Twice a day
		Medical	Medical waste box/4	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/2	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/3	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/2	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/10	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/1	Cleaning Per.2-10-14	Twice a day
		Paper	Waste paper box/2	Cleaning Per.2-10-14	Once a week
		Domestic	Domestic box/10	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/7	Cleaning Per.2-10-14	Twice a day
		Paper	Waste paper box/3	Cleaning Per.2-10-14	Once a week
		Domestic	Domestic box/1	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/10	Cleaning Per.2-10-14	Twice a day
		Paper	Waste paper box/4	Cleaning Per.2-10-14	Once a week
		Contaminated	Contaminated box/6	Cleaning Per.2-10-14	Once a day
		Metal	Box/1	Cleaning Per.2-10-14	Once a day
		Domestic	Domestic box/6	Cleaning Per.2-10-14	Twice a day
		Metal	Box/1	Cleaning Per.2-10-14	Once a day
		Contaminated	Contaminated box/6	Cleaning Per.2-10-14	Twice a day
		Domestic	Domestic box/1	Cleaning Per.2-10-14	Once a day
		Paper	Waste paper box/5	Cleaning Per.2-10-14	Once a week
		Domestic	Domestic box/3	Cleaning Per.2-10-14	Once a day
		Paper	Waste paper box/6	Cleaning Per.2-10-14	Once a week

5.2 Realization of Objective 2: Management of Waste Water

To manage waste water ,which was second objective, after sewerage connection permission has been taken from free zone management, to control waste water quality, analysis in authorized laboratory has made and has been followed once every three months.

To provide assuring discharge parameters for the waste water, all employees were informed. Sewerage connection permission has been granted only for domestic waste water and the discharge parameters are acceptable for domestic waste water. Therefore chemicals should not have been drained into sewerage system and it was collected in the new chemical warehouse.

5.3 Realization of Objective 3: Management of Waste Area and Chemical Warehouse

To realize last objective, i.e. management of waste area and chemical warehouse, existing waste area was not safe and suitable for hazardous waste and chemical warehouse storage. Therefore, design and construction of a new waste area and new chemical warehouse have been decided. As a results of this study, new waste areas for contaminated waste, paper and cardboard waste, hazardous and non-hazardous waste, scrapping waste materials, contaminated barrels have been planned, basic requirements of these waste sites defined and constructed. After that, management procedures for these waste areas have been developed.

Firstly, new waste area specifications have been decided by environmental engineer. The conditions required by the new site are given below,

- To locate waste area separately from other buildings
- To reinforce concrete construction
- A leak-proof construction
- To include firefighting system

Waste area has been planned in seven different parts. New waste containers that should be safe and leak-proof were provided during the construction period. The labels including waste name, quantity, and storage date were prepared for each container.

After construction completed, waste containers were placed in the new waste area and labels were stuck on the containers.

In the operation, cleaning personnel were defined as responsible from internal waste transfer and storage. Therefore, cleaning personnel have been trained about this issue. And their responsibilities and duties have been described.

5.3.1 Waste Area-1 Management

Waste area-1 has been designed for contaminated waste, i.e. contaminated waste and contaminated packaging waste. Contaminated waste contains cleaning materials, personal protective equipment which contaminated with chemical materials; and contaminated packaging, i.e. chemical materials storage containers.

These wastes are hazardous therefore, their containers should be leak-proof, safe and the containers should have a cover. Their covers must be closed.

Waste area-1 has been controlled daily by environment engineer. Check list points are given below;

- To control status of covers
- To control storage capacity
- To control leakage and spillage
- To control conformity to layout

5.3.2 Waste Area-2 Management

Waste area-2 has been designed for paper and cardboard waste. These wastes have been stored in there and baled with press machine. Paper and cardboard waste have been separated in their sources. Paper waste sources are offices and cardboard waste sources are packaging center. These are non-hazardous waste.

After waste collection, cleaning personnel, who are trained for this duty, bales waste and stores in waste area-2. If storage capacity is full in waste area-2, external waste transfer has been organized by environmental engineer. Bales have been sent to a recycle company.

Environmental engineer have controlled daily the waste area. Check list points are given below;

- To control storage capacity
- To control press machine
- To control conformity to layout

5.3.3 Waste Area-3 Management

Waste area-3 has two different parts. Hazardous and non-hazardous waste can be temporary stored in the area. Waste which are stored in the waste area is given below,

- Domestic waste
- Medical waste
- Solid resin waste
- Fluorescence waste
- Waste battery
- Waste accumulator

Domestic waste includes waste from canteen and dining hall. Domestic waste is not hazardous and can be degraded biologically. For biodegradation, domestic waste must be separated from source to removal. Its container cover must be closed to prevent odor.

Medical waste comes from health offices. It is hazardous for environment and human. Waste box in health office is special for medical waste. The box is made solid material to protect cleaning personnel that is responsible from internal waste transfer. Cleaning personnel should put on gloves and hold off carefully. Medical waste box is put in medical waste container at waste area but definitely, it should not be opened and emptied which is very important for personnel protection. Medical waste container in waste area is a special container that is designed for medical waste. The container is put in lock and covers always must be closed and locked.

Solid resin waste is organic solver or filler and resin include other hazardous material. Its containers are made metal material. The aim is here to increase carrying capacity. Solid resin waste is heavier than other waste.

Fluorescence light is used for lighting at the plant. The light includes mercury. Therefore, their wastes are hazardous waste. When light is needed to change, technicians change carefully. Fluorescence should not be cut break. If it is broken, mercury contaminates environment. After changing the light, technicians roll the light with cardboard and put in suitable waste container.

Battery and accumulator include dangerous materials. Their wastes are also hazardous waste. Waste batteries are collected in dining hall, reception and service area. Its waste box is made solid and leak proof material. When waste battery box is full, cleaning personnel, bring away in waste area. Waste accumulators are put in waste area by technician. When accumulators are changed, waste accumulators are occurred.

Waste area-3 has been controlled daily by environment engineer. Check list point are given below;

- To control status of cover
- To control storage capacity
- To control leakage and spillage
- To control conformity layout

5.3.4 Scrap Area Management

Electronic waste, metal waste and wire waste are temporary stored in the area. Metal waste and wire waste are non-hazardous waste but electronic waste is hazardous waste. Some semi-produced ignition coils which are not suitable as a finished product as per quality standards, generates electronic waste. Therefore, they are crashed in special machine and then they are disposed.

Scrap area has been controlled daily by environment engineer. Check list point are given below;

- To control status of cover
- To control storage capacity
- To control conformity layout

5.3.5 Contaminated Barrel Area Management

Resin and hardener are stored in drums. Drums are metal, leak-proof and 220 liter barrels. When resin or hardener drums are emptied, the drum is called contaminated barrel. They are hazardous waste because dangerous chemicals are still in drum. In other words, drums are contaminated by chemicals.

The waste area is designed to suit leakage and spillage. If spillage or leakage is occurred, the waste area has sewer system which is not connected to other sewer systems.

After noticing leakage and spillage, absorbents are settled on chemical in the sewer system. The process, which is called absorption, should have continued until all chemical absorbed. Than the absorbents should have gotten rid of as contaminated waste.

Contaminated barrel area has been controlled daily by environment engineer. Check list point are given below;

- To control status of cover
- To control storage capacity
- To control leakage and spillage
- To control conformity layout

5.3.6 Scrap Wooden Palet Area Management

Wooden pallet waste is generated by warehouse. If wooden pallet is crashed during shipment, it is called waste wooden pallet. They are non-hazardous waste.

The waste area is separated from other areas because the waste area has high probability of fire.

Wooden pallet area has been controlled daily by environment engineer. Check list point are given below;

- To control storage capacity
- To control conformity layout

5.3.7 Plastic Scrap Area Management

Plastic scrap is non-hazardous waste. Different kind of plastic raw materials are used in plastic plant therefore; different kind of plastic wastes are occurred in there.

5.3.8 Chemical Warehouse Management Procedure

Chemical materials were used and stored at ignition coil production plant. But the storage condition had not been safe for environment and health. In the meantime, special area was built to store and distribute chemical materials which is called chemical warehouse.

Chemical warehouse is located separately than other buildings. The separation aim is to minimize safety risk of chemical materials. The warehouse was projected as reinforced concrete building. To protect soil and to prevent chemical leakage and spillage, its floor was projected also reinforced concrete and epoxy coating. In addition, there is a sewer, which is not connected to sewerage system and storm sewer system, to prevent leakage and spillage by interlinking.

Chemical materials had different boiling points in chemical warehouse for this reason aspiration system is installed. Air and chemical vapor in chemical area has been replaced every half an hour to minimize probability of fire. On the other hand, to minimize chemical vapor, chemical and waste storage container covers should be closed.

All chemical materials, which are used in the plant, were collected in chemical warehouse. These chemical materials storage conditions and storage capacities are given Table 5.14 below.

Table 5.14 Chemical materials storage conditions and storage capacities in the plant

Chemical Material	Storage Condition	Storage Capacity
Resin	Drum (220 l)	220 l
Hardener	Drum (220 l)	220 l
Solder	Box	220 l
Alcohol	IBC Tank	1000 l
Solvent	IBC Tank	1000 l
Oil	IBC Tank	1000 l
Glue	Closed container (≤30 l)	60 l
Thinner	Closed container (≤30 l)	60 l
Silicon	Closed container (≤30 l)	50 l
Reactor coolant	Closed container (≤30 l)	50 l
Cleaning Materials	Closed container (≤30 l)	120 l

Waste which is occurred chemical materials usage were stored in chemical warehouse. These waste storage conditions and storage capacities are given Table 5.15 below.

Table 5.15 Waste which are in chemical warehouse storage conditions and storage capacities

Waste	Storage Condition	Drum Capacity	Storage Capacity
Waste Solvent	Drum	220 l	220 l x4
Waste alcohol	Drum	220 l	220 l x2
Waste Oil	Drum	220 l	220 l x4
Waste Resin and hardener	Drum	220 l	220 l x2
Waste Flux	Drum	220 l	220 l x1

These chemicals and wastes are hazardous and liquid phase because of that reason storage conditions and work instruction rules were determined and controlled daily.

A procedure which is called chemical warehouse management procedure, was formed. The procedure contained work instructions, rules about chemical warehouse,

authorized persons, usage of personal protective equipment, time when enter chemical warehouse and emergency situation in chemical warehouse.

Six work instructions were prepared under chemical warehouse management procedure. These are,

- Working order for to bring alcohol
- Working order for to bring oil
- Working order for to bring solvent
- Working order for to purge oil
- Working order for to purge solvent
- Working order for leakage or spillage

Rules about chemical warehouse is given below,

- Chemical warehouses door has to be closed and locked expect operating time.
- Employee does not have to use phone in chemical warehouse.
- Fire does not be have to use in chemical warehouse.

Environmental engineer, health and safety engineer and utilities manager were authorized persons for the warehouse. Its key was at the authorized persons and security team. Security team can use the key only emergency situation.

During all chemical warehouse process, personal protective equipment, which are mask, glasses, glove, should be used by employees.

Time when enter the warehouse was defined. Chemical warehouse could have been used between 09:00 am- 17:00 pm. When emergency situation is occurred, the defined time can be changed by authorized persons.

For possibility of fire, fire extinguisher tube has been placed in the warehouse. Employees, who need to enter chemical warehouse, participated fire protective training.

To control chemical warehouse, training was prepared to describe work instruction methods in chemical warehouse. Employees, who need to enter chemical warehouse, was determined and listed. Human resources department and environmental engineer organized the training for that group of people. Work instruction of chemical warehouse training was lectured by environmental engineer. In this way, employees who enter the warehouse was specified and trained.

After this improvement that was renewed waste area and chemical area, environmental impacts, which were hazardous waste, non-hazardous waste, chemical leakage or spillage, were decreased for the waste and chemical area. The reduction at environmental impacts are shown at Table 5.16.

Table 5.16 Results of environmental impact reducing evaluation for waste and chemical area

No	Aspect	Impact	Evaluation	Source	P1	P2		P3	P4	P5	Score	Normal	Abnormal	Emergency
1	Non-hazardous waste storage	Non-hazardous waste	Before this study	Waste and Chemical Area	2	s	2	4	4	1	64	X		
2			After this study	Waste and Chemical Area	2	-	1	4	1	1	8	X		
3	Hazardous waste storage	Hazardous Waste	Before this study	Waste and Chemical Area	2	s	2	4	4	1	64	X		
4			After this study	Waste and Chemical Area	2	-	1	4	1	1	8	X		
5	Contaminated personal equipment	Hazardous Waste	Before this study	Waste and Chemical Area	2	s	2	3	1	1	12	X		
6			After this study	Waste and Chemical Area	2	-	1	3	1	1	6	X		
7	Chemical materials storage	Chemical Spillage or Leakage	Before this study	Waste and Chemical Area	2	s,w	4	4	4	1	128		X	
8			After this study	Waste and Chemical Area	2	-	1	4	1	1	8	X		

5.4 Realization of Objective 4: Training of employees about environmental consciousness

To assure conformation of EMS, each employee should make an effort. Human resources department and environmental engineer are responsible of employee trainings about environmental consciousness in the plant. With these responsibilities, to perform last objective which was to train employees about environmental consciousness, annually training plan which is shown below at Table 5.17, has been formed and training has been started.

Table 5.17 Training Plan for 2012

No	Training	Training Nominee	2012											
			January	February	March	April	May	June	July	August	September	October	November	December
1	Environmental Training at Orientation	New comers	●	●	●	●	●	●	●	●	●	●	●	●
2	Segregation of Waste	All employee	●						●					
3	Chemical Leakage	All employee	●						●					
4	Usage of Waste Area	Cleaning staff	●			●			●			●		
5	Usage of Chemical Warehouse	Cleaning staff	●			●			●			●		
6	Emergency Situation	All employee	●						●					

CHAPTER SIX
CONCLUSION

At the end of this study, there were two main challenges that we would like to perform in this thesis. The first was to create EMS according to ISO 14001 and free zone procedures and the second was to implement the system. Two challenges were realized at this study. Furthermore, to assure conformation of EMS, specific improvements for the plant were realized. These improvements are explained below.

Waste types and quantity were defined and analyzed. Appropriate waste containers for each waste type were placed at their sources. Waste which can be recycled were determined. Before this study, recyclable waste and disposal waste were mixed at the plant. Therefore, not all recyclable waste could have been recycled. Waste separation at source was started and developed. By this way, recyclable waste and disposal waste were not mixed any longer. With this improvement, all recyclable waste were recycled by recycle company so the recycling ratio was increased from 48% to 65%. Environmental impact of the waste that was disposed before this study was also reduced by recycling.

New waste area and new chemical warehouse which is suitable and safe for hazardous waste and chemical storage were designed and constructed. Basic requirements of these waste sites defined and management procedures for these waste area and chemical warehouse have been developed.

Internal waste transfer was organized, external waste transfer methods which include free zone procedure, were defined, and external waste transfer was organized. In consequence with the definition of external waste transfer methods, which is an improvement for the plant, course of actions for legislation conformity are determined.

With EMS implementation, plants environmental aspects and impacts have been controlled and have been started to monitor. To monitor EMS, internal audit system was established and internal audit checklist for the plant was issued.

To manage waste water, sewerage connection permission, which is a legal obligation for the plant since it is located in free zone, has been granted from free zone management and waste water quality was started to be controlled and followed.

In the beginning of this study, ISO 9001 Quality Management System and ISO 16949 Quality Management System are implemented at present situation in the plant. Therefore, employees and management was familiar with system culture which helped to implement EMS according to ISO 14001. On the other hand, it is aimed to increase environmental consciousness at the plant. Thus, training about this issue was planned and started so EMS was guaranteed to continue.

As a result, of this study shows that ISO 14001 EMS standard and free zone procedure were applied successfully in the plant.

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