DOKUZ EYLÜL UNIVERSITY
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MANAGEMENT APPROACHES FOR INDUSTRIAL WASTE WITH RESPECT TO ISO 14000

by
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İZMİR

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ABSTRACT

Environmental pollution has been one of the significant problems that the world is facing. Rapidly developing industrialization cause negative effect on environment, human and nature. Developing environmental performance of organizations would decrease these negative effects. ISO 14000 Environmental Management System undertake important role for controlling this environmental impacts of industies.

For a case study an iron and steel company located in İzmir had observated for nine weeks. In this time interval an initial review according to ISO 14001 was completed.

According to the outputs of the observation period ISO14001 strategy of the company is discussed and possible waste management approaches are offered in the content of the study.

Furthermore, an experimental study conducted for reuse of slag, which is the major waste of the factory, and the results are presented. In experimental study, slag used as an additive in mortar in different ratios and the increase in pressure strength of the material has determined.

Keywords: Environmental Management System, ISO 14000, ISO 14001, initial review, slag, Compressive Strength

ISO 14000 ÇEVRE YÖNETİM SİSTEMİ İLE
ENDÜSTRİYEL ATIK YÖNETİMİ

ÖZ

Çevre kirliliği tüm dünyada en önemli sorun olarak karşımıza çıkmaktadır. Sanayinin hızla gelişmesi çevre, insan ve doğa üzerinde olumsuz etkilere neden olmaktadır. İşletmelerin çevre performanslarını arttırmasıyla bu olumsuz etkiler azalacaktır. ISO 14000 Çevre Yönetim Sistemi bu etkilerin kontrol edilmesinde önemli bir rol üstlenmektedir.

Konu çalışması için, İzmir'de kurulu olan demir çelik fabrikasında dokuz hafta boyunca gözlem yapılmıştır. Bu süre içerisinde ISO 14000 Çevre Yönetim Sistemi'ne göre başlangıç mahiyetinde gözden geçirme tamamlanmıştır.

Gözlem süresince elde edilen verilere göre firmanın ISO 14000 stratejisi tartışılarak, uygulanabilecek atık yönetim yaklaşımları çalışma içerisinde belirtilmiştir.

Ayrıca bu çalışmada, fabrikanın en önemli atığı olan curufun tekrar kullanılması için deneysel çalışmalar yapılmış, deney sonuçları sunulmuş ve irdelenmiştir. Beton harcı içerisine farklı oranlarda curuf eklenmiş ve basınç dayanımlarındaki artış ölçülmüştür..

Anahtar kelimeler: Çevre Yönetim Sistemi, ISO 14000, ISO 14001, ön hazırlık çalışması, curuf, beton dayanımı.

CONTENTS

CHAPTER ONE
INTRODUCTION

1.1. Study Overview

Environment is effect as direct or indirect with increase industrialization in the world. Therefore environment spoil day by day. Ozone depletion, global warming, deforestaration and other environmental issues were making front-page news around the world and were being viewed as global problems (Cascio, J., & Woodside, G.,& Michell, P.,1996). Developed countries generally are be cause this situation. It makes an effort to protect the environment. Environmental management system developed to be active industrialist's effort and sensitivity.

As the first standard of the environmental management system standard series, ISO 14001 standard was established in 1996 by international committee to provide industries with a structure for a universal and international environmental management system of standards and guidelines.

The standard requires a certificated company to demonstrate commitment to continual improvement in environmental performance and to have an environmental management system which covers all the significant environmental aspects or effects which the company can control or influence.

ISO 14001 provides a framework to direct the use of organizational resources to the full breadth of actual and potential environmental impacts through reliable management processes and a base of educated and committed employees. Regulatory compliance is now a normal results of this management strategy, along with awareness, sensitivity and preparedness (Cascio, et all,1996).

1.2 The Aim Of The Study

Recently, organizations is implementing an ISO 14001 environmental managenment system for improvement their environmental performance, because of consumers pressure. Environmental damages of process are minimized by controlling at all steps from entering raw meterial to final product.

The objectives of my thesis are:

• To identify the environmental management system according to ISO 14000 Standard,

• To evaluate a guideline for working on iron and steel industry, and to show the improving and implementing steps of an environmental management system for such organizations,

For this purpose, iron and steel industry is chosen as a case study area and ISO 14001 Environmental Management System requirements have been improved step by step for this facility.

CHAPTER TWO
ENVIRONMENTAL MANAGEMENT SYSTEM

2.1 Environmental Management System

Most manufacturers or companies have processes or products they use their facility that may have the potential to negatively effect the environment. These facilities are a major concern in the fight for improved environmental conditions. A solution to help companies do their part in helping control their potential impacts is to implement an Environmental Managenment System (EMS). EMS's play an important role in determining a company's environmental success (Shoemaker, R.D,2005).

EMS's are a step in the right direction to helping to control decreasing environmental contions. It serves to provide a framework that companies can follow to maintain and provide upon their contributions and impacts on the environment.

The key systems components of an EMS are:

- An Environmental Policy Statement actively promoted by top management
- A Planning Process oriented toward integration of environmental with the organization's
- Business and operations management
- An Organizational Structure, responsibilities and accountability
- Implementation Systems and Operational Controls
- Measurement and auditing systems
- Systems for periodic Top Management Review of the EMS (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

Currently there are several certifiable EMSs, including a British standard (BS 7750), European standard (EMAS), a worldwide standard (ISO 14001).

2.2 British Standards (BS 7750)

In 1992, the British Standard Institute (BSI) adopted an EMS known as BS 7750. After a revision in 1994, the BSI adopted second edition of the BS 7750, which is the version currently used today. BS 7750 is an EMS that focuses on providing steps for a facility to take in order to effectively implement an environmental managenment sysytem. This EMS provides specific instructions for a facility to integrate the system and on how to ensure compliance, rather then just providing a guidance document like its similar environmental managenment systems, EMAS and ISO 14000. The BS 7750 EMS is designed with intentions of improving environmental performance by addressing a facilities' environmental impacts. The British EMS is a systematic apporoach to environmental managenment, by steps of creating environmental policy and objectives, followed by managenment auditing (Shoemaker, R.D,2005).

2.3 The Eco- Management and Audit Scheme (EMAS)

The Eco-Management and Audit Scheme, EMAS, allows voluntary participation in an environmental management scheme for organizations operating in the European Union and the European Economic Area. The scheme has been operative since April 1995. It aims to promote continuous evaluation and improvements in the environmental performance of participating organizations (Gateway to the Europian Union (n.d).

EMAS focuses on continuous improvement by facilities and to aim to help minimize industry's bad environmental performance. It provides a framework for facilities to follow in helping to decrease their contributions to degrading environmental quality (Shoemaker, R.D,2005).

In 1997 the consultation process began, which took the above changes into consideration. The Commission adopted a proposal which went through the codecision procedure, involving other European institutions (Economic and Social Committee, Council of the Regions) and giving the European Parliament similar rights to the Council in the decision process (Gateway to the Europian Union (n.d).

In 2001 the new Regulation (EC) No 761/2001 was adopted. Its main elements are: (Gateway to the Europian Union (n.d).

- the extension of the scope of EMAS to all sectors of economic activity including local authorities;
- the integration of ISO 14001 as the environmental management system required by EMAS, so that progressing from ISO 14001 to EMAS will be smoother and not entail duplication;
- the adoption of a visible and recognisable EMAS logo to allow registered organizations to publicise their participation in EMAS more effectively;
- the involvement of employees in the implementation of EMAS;
- the strengthening of the role of the environmental statement to improve the transparency of communication of environmental performance between registered organizations and their stakeholders and the public; and
- a more thorough consideration of indirect effects including capital investments, administrative and planning decisions, procurement procedures, choice and composition of services (e.g. catering) (Gateway to the Europian Union (n.d).

The main stages involved in achieving EMAS registration are as follows:

- *Investigating* an organization's interactions with the environment in an environmental review;
- *Establishing* an effective environmental management system on the basis of the review aimed at improving the environmental performance of the organisation;

- *Communicating* environmental performance data in an environmental statement. This statement is verified by a third party to provide external credibility to this performance-reporting element (Gateway to the Europian Union (n.d).

2.4 ISO 14000

Industry being one of the largest contributors to degrading environmental conditions, has gained an increased popularity in the eye of the public. The need for the creation of a system to deal with negative environmental conditions has been established, and the answer is in the environmental managenment system ISO 14000 series of standards. ISO 14000 is an environmental managenment series of standards that was developed by International Organization of Standardization (Shoemaker, R.D,2005).

ISO 14000 standards, voluntary standards, provide for a systematic approach to managing to minimizing a company's environmental impacts result in from operations.

The ISO 14000 standards are a factor in international development and commerce for numerous reasons, three of which are key. First, the standards facilitate trade and remove trade barriers; second, the creation of the standards are improve environmental performance worldwide; and third, these standards build worldwide consensus that there is a need for environmental management and for a common terminology for environmental management systems (Cascio, et all,1996).

2.5 Development of ISO 14000

In 1946, delegates from 25 countries met in London and decided to create a new international organization, of which the object would be "to facilitate the international coordination and unification of industrial standards". The new organization, ISO, officially began operations on 23 February 1947 (International Organization for Standardization, (n.d.)).

The International Organization for Standardization (ISO) developed the ISO 14000 series of standards based on the need expressed at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 for improved environmental quality (Science Direct, (n.d)).

In 1992, the British Standards Institute (BSI) published BS 7750, the first national standard for environmental management systems. BS 7750 is an EMS that focuses on providing steps for a facility to take in order to effectively implement an environmental management system. (Shoemaker, R.D,2005).

In addition to the national EMS standards, European legislation was developed. The Eco- Management and Audit Scheme (EMAS) was adopted by the European Union in 1993. EMAS is a regulation that enables industries to voluntarily implement formal environmental management systems in order to improve their environmental performance (Tekneci, 2004).

The ISO established Technical Committee (TC) 207 in 1993 to develop the ISO 14000 series environmental standards.

In September 1996 the first of the ISO 14000 series of standards, ISO 14001, was issued.

In Turkey the draft of ISO 14001 standard was published in April 1997. The Standard became certain as “TS EN-14001 Environmental Management Systems, Facilities and Guidelines”.

The latest version of the ISO14001 standard and Guidance document (ISO 14004:2004) have just been released as of November 15, 2004.

2.6 The Diffrences Between ISO 14001 & BS 7750 & EMAS

Table 2.1 The diffrences between ISO 14001 & BS 7750 & EMAS (Uzun, 1999)

ISO 14001	BS 7750	EMAS
Voluntary, consensus, private sector Standard	National, voluntary standard	European Union regulation
Applies to the international area	Applies in the UK, but be applied anywhere developed	Applies across the whole of the EU
Can apply to the whole organization or part of an organization	Can apply to the whole organization	Applies the sites only
Applicable to an organization's activities, product and services in any sector	Open to any the sector or activitiy	Restricted to site-specific industrial activities
Focus on organizations implementing EMS; indirect link to environmental improvements emerging from the system	Focus on organizations implementing system, environmental improvements emerge from the system	Direct focus environmental performance improvements at a site and the provision of information to the public
Identification of aspects is required in the specification; an initial review is suggested in the informative annex	Preparatory environmental review advisable but not a specification of the Standard	Initial environmental review is essential
Environmental policy commitment to continuous	Environmental policy commitment to continual	Environmental policy commitment to continual

improvement of EMSs and compliance with relevant environmental legislation	improvement of environmental performance, no refence to legislation in the standard specification	improvement of environmental performance, and and compliance with relevant environmental legislation
Audits of the EMS are required; monitoring and measuring of key environmental characteristics are required	Audits of the EMS are required; audits for compliance or environmental performance are not required	Audits of the EMSs, precesses data, and environmental performance are required
Frequency of auditsis not specified	Frequency of auditsis not specified	Audits are required at least every 3 years
Only environmental policy must be publicly available; other external communications must be considered, but what is communicated is left to management	Only environmental policy must be publicly available; other external communications must be considered, but what is communicated is left to management	A description of the environmental policy, program, and management system nust be made available to the public; a public environmental statement and annual simplified statement including factual data are required
Document is more clearly structed		Confusing arrangement (a lot of cross references)

2.7 The Number of ISO 14001 Certification of the World

ISO 14000 standards build worldwide consensus that there is a need for environmental managenment and for a common terminology for environmental managenment systems (Cascio, et all,1996).

Today, ISO 14001 is widespread recognized international marker for environmental management system development.

As of 2004, the overall number of ISO 14001 certified companies exceeded 74,000 companies and organizations worldwide in Figure 2.1 As shown, Japanese organizations alone hold an impressive share 23% of total ratio (Gateway to the Europian Union (n.d).

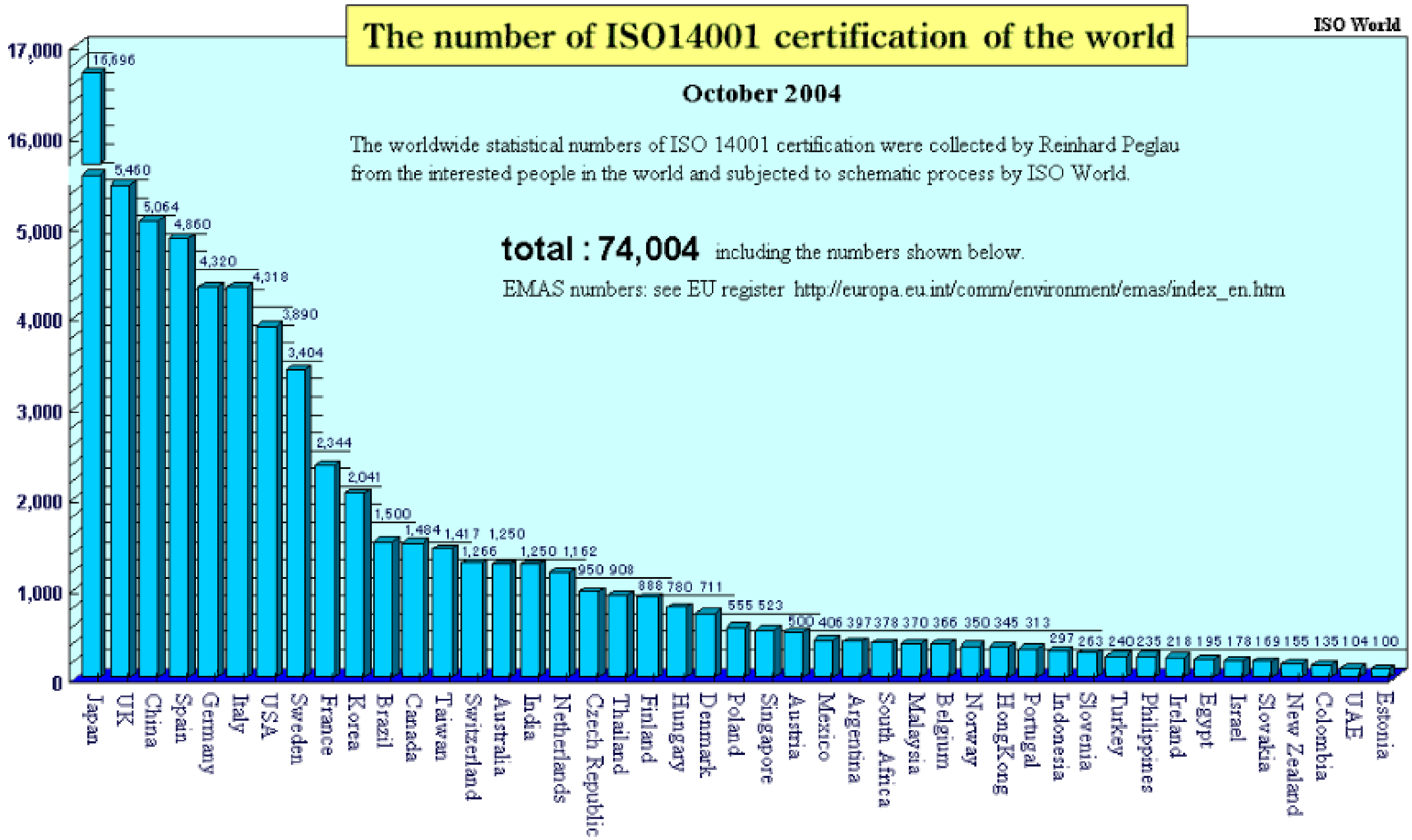

Figure 2.1 The number of ISO 14001 certification of the World

2.8 Benefits of ISO 14000

There are many reasons for implementing an EMS. Businesses recognize that a focus on “command and control” by itself does not provide the bottom line results desired. ISO 14001 has proven to be a useful tool to evolve from maintaining regulatory compliance to a position of improved productivity and enhanced competitive advantage.

There is mounting evidence that companies which manage not only the Standard economic factors but also the environmental and social factors affecting their business show financial performance superior to those which fail to manage all three (Environmental, Health, Safety, and Quality Management Services for Business and Industry, and Federal, State, and Local Government, (n.d.))

The whole ISO 14000 family provides management tools for organizations to control their environmental aspects and to improve their environmental performance. Together, these tools can provide significant tangible benefits, including; (International Organization for Standardization, (n.d.))

- Improved process efficiency
- Reduced raw material/resource use
- Reduced waste generation and disposal costs
- Cost savings from greater attention to waste reduction, materials and energy use
- Utilization of recoverable resources
- Meeting customer requirements
- Generating competitive advantage
- Potentially more attractive to investors/shareholders
- Better access to bank loans/insurance
- Environmental cost reduction
- Reduced environmental accidents
- Compliance with environmental legislation and regulation

- Better relationships with regulators
- Marketing advantages
- Better control of liabilities
- Protection of company image and name
- Cost savings in insurance premiums due to the lower risk involved.
- Improved motivation of staff.
- Improved relationships with staff, suppliers, customers and authorities.

(International Organization for Standardization, (n.d.)).

2.9 ISO 14000 Family

The ISO 14000 series fall into two main categories:

- Organization evaluation standards
- Product evaluation standards

Table 2.2 ISO 14000 family

	ISO 14000 FAMILY	
Organization Evaluation	Environmental Management Systems	ISO 14001 ISO 14004 ISO/TR 14061
	Environmental Auditing	ISO 14010 ISO 14011 ISO 14012 ISO 14015 ISO 19011
	Environmental Performance Evaluation	ISO 14031 ISO/TR 14032
	Environmental Management Vocabulary	ISO 14050

t Ev al	Environmental Labelling	ISO 14020 ISO 14021 ISO 14022 ISO 14023
		ISO 14024
		ISO/TR 14025
	Life Cycle Assessment	ISO 14040 ISO 14041 ISO 14042 ISO 14043 ISO/TR 14047 ISO/TS 14048 ISO/TR 14049
	Environmental Aspects in Product Standards	ISO/TR 14062 ISO Guide 64
	Environmental Management Vocabulary	ISO 14050

2.9.1 Organization Evaluation

➢ **Environmental Management System**

ISO 14001 "Environmental Management Systems - Specification with Guidance for Use"

ISO 14004 "Environmental Management Systems - Guidelines on Principles, Systems and Supporting Techniques"

ISO/TR 14061 "Information to assist forestry organizations in the use of the Environmental Management System standards ISO 14001 and ISO 14004"

➢ **Environmental Auditing**

ISO 14010 "Guidelines for Environmental Auditing - General Principles on Environmental Auditing"

ISO 14011 "Guidelines for Environmental Auditing –Auditing of EMS"
ISO 14012 "Guidelines for Environmental Auditing - Qualification Criteria for Environmental Auditors"

ISO 14015 "Environmental management - Environmental assessment of sites and organizations (EASO)"

ISO 19011 **"**Guidelines for quality and/or EMSs auditing (This standard replaces ISO 14010,14011 and 14012)"

- **Evaluating Environmental Performance**

ISO 14031 "Environmental management - Environmental performance evaluation - Guidelines"

ISO/TR 14032 "Environmental management – Examples of environmental performance evaluation (EPE)"

ISO/WD 14063 **"**Environmental management - Environmental communications – Guidelines and examples (to be determined)"

- **Vocabulary**

ISO 14050 "Environmental management – Term & Definitions"

2.9.2 Product Evaluation

- **Environmental Labeling and Declarations**

ISO 14020 “Environmental labels and declarations – General principles”

ISO 14021 “Environmental labels and declarations – Self-declared environmental claims (Type II environmental labeling)”

ISO 14022 “Environmental Labeling and declarations - Symbols”

ISO 14023 “Environmental Labeling and declarations - Testing and Verification Methodologies”

ISO 14024 “Environmental labels and declarations – Type I environmental labelling - Principles and procedures”

ISO/TR 14025 “Environmental labels and declarations(Type III environmental declarations)”

- **Life Cycle Assessment**

ISO 14040 “Environmental management – Life cycle assessment –Principles and framework”

ISO 14041 “Environmental management – Life cycle assessment – Goal and scope definition and inventory analysis”

ISO 14042 "Environmental management – Life cycle assessment –Life cycle impact assessment"

ISO 14043 "Environmental management – Life cycle assessment –Life cycle interpretation"

ISO/TR 14047 "Environmental management –Life cycle assessment –Examples of application of ISO 14042 (to be determined)"

ISO/TS 14048 "Environmental management – Life cycle assessment –Data documentation format"

ISO/TR 14049 "Environmental management – Life cycle assessment – Examples of application of ISO 14041 to goal and scope definition and inventory analysis"

- **Environmental Aspects in Product Standards**

ISO/TR 14062 "Environmental management – Integrating environmental aspects into product design and development"

ISO Guide 64 "Guide for the inclusion of environmental aspects in product standards"

- **Vocabulary**

ISO 14050 "Environmental management – Term & Definitions"

NOTES: AWI: Approved Work Item
WD: Working Draft
CD: Committee Draft
DIS: Draft International Standard
FDIS: Final Draft International Standard
DTR: Draft Technical Report
TR: Technical Report

* ISO/IEC Guide 66 was developed by the ISO Policy development Committee on conformity assessment (ISO/CASCO)

CHAPTER THREE
ISO 14001 EMS STANDARDS

3.1 ISO 14001

ISO 14001 is a standard within the ISO 14000 series of standards. ISO 14001 focuses on providing the basic framework for establish a quality Environmental Managenment System. The 14001 standard defines basic requirentments for managing and controlling environmental impacts. ISO does not work by giving specific instructions on how concentrate on a facilities' efforts on managing their impacts. The standard lets the facility and allow then to create the needed approach to identifying environmental problems (Shoemaker, R.D,2005).

An ISO 14001 certification is based on the principles of continual improvement: Plan, Do, Check, Act. This principle is named Deming Cycle.

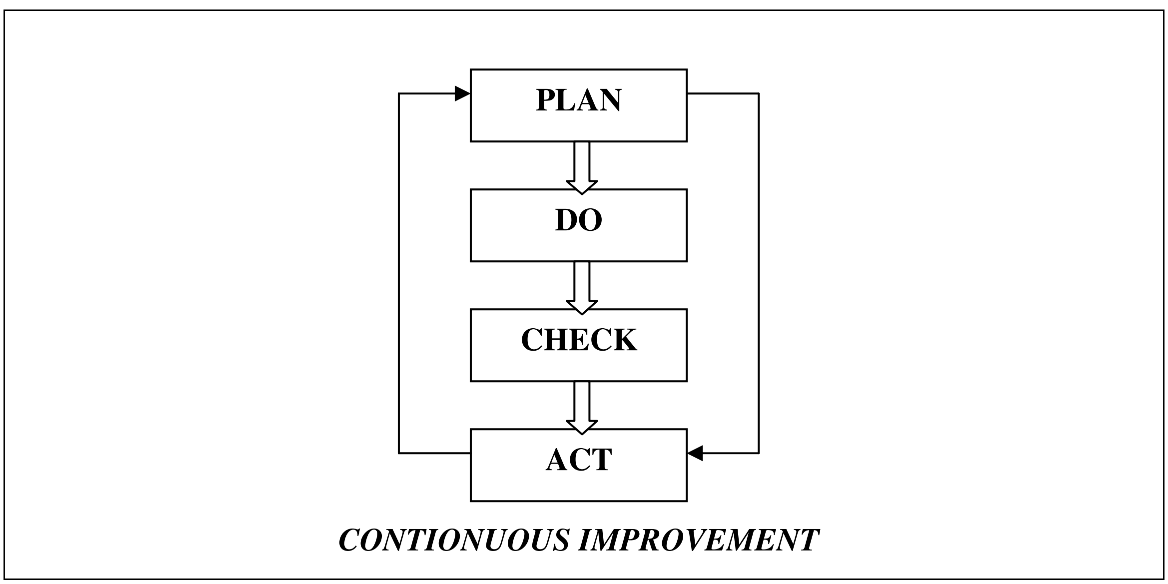

Figure 3.1 Deming Cycle

The environmental management system requirements are described in the following five main elements of the standard:

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

3.2 Environmental Policy

ISO 14001 environmental standart requires that a facility establishes a statement that will describe all of its goals and intentions regarding improvement to the environment. An environmental policy allows a company to organize its efforts and commit itself to achieving important environmental goals (Shoemaker, R.D,2005).

An environmental policy can be based on guiding principles, such as those discussed previously, and tailored to fit an individual organization. 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, leaership, and direction for the organization's environmental initiatives (Cascio, et all,1996).

Implementing a sound EMS depends on commitment from all levels of management and employees, but commitment from top management is of utmost importance. Top management should ensure that the policy is implemented throughout the organization. The commitment from top management to sound environmental practices serves as the basic for developing and improving the EMS (Cascio, et all,1996).

The broad environmental goals defined by ISO 14001 standard include, prevention of pollution, complience with legal and regulatory requirements, and establishes the need for commitment to continuous improvement. All of these goals are required indirectly to be stated in the environmental policy (Shoemaker, R.D,2005).

Content Requirements of the Environmental Policy:

- 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.)).

3.3 Planning

In the ISO 14001 standard the planning phase of the standard follows the development of the Environmental Policy statement. However, it may be difficult to finalize the Environmental Policy statement until the planning phase has been completed.

The planning phase contains four distinct steps:

- Environmental Aspects
- Legal and Other Requirements
- Objectives and Targets
- Environmental Management Program

3.3.1 Environmental Aspects and Impacts

Environmental aspects defined in ISO 14001, "element of organization's activities, products, and services which can interact with the environment" (Cascio, et all,1996). Environmental aspects have an interaction potential that can be defined as either good or bad.

There are there different types of aspects that a company may identify with, the first being *Operational Aspects*. Operational Aspects may include any materials that are into a product that lead to its completion. An example of an Operational Aspect is chemicals that are used in a facilities process for manufacturing. A second type of environmental aspects is *Products Aspects*. These aspects identified as being environmental impacts in association with the finished product. It may include aspect area of finished product packing materials or a chemical material that may have the potential to displace off the finished product and cause a chance. Since product aspects are associated with the finished product, they are sometimes looked at as being out of the control of the manufacturing facility. After the finished product is shipped off site to the consumer, it is then the responsibility of the consumer to determine its environmental fate. The manufacturer of the original product is limited in their control of its impact to the environment. The final type environmental aspects are *Service Aspects*. Service Aspects are defined as being related to any service that is provided by and outside source to the facility. Any service that is brought onsite, is then the responsibility of the facility. If a contractor is brought onsite and has a chemical spill that is released in to the environment, it than becomes the responsibility of the facility. This area also needs to be addressed in identifying environmental aspects (Shoemaker, R.D,2005).

After identifying all of the facilities' environmental aspects, the next steps is to determine the aspects' impact on the environment. The main focus is to asses each environmental aspect and evaluated how that aspect will impact environmental. 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 all, 1996).

Now that all aspects have been identified and their impacts or change to the environment have 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, R.D,2005).

It is responsibility of the core team to use a number system that is composed of pre-determined 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, contaminetion 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 assesment of determined environmental aspects and impacts (Shoemaker, R.D,2005).

The numbering system is designed to evaluated the significance level of each pre-determined 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 consistant level of comporison (Shoemaker, R.D,2005).

3.3.2 Legal Requirements

Another component of the planning process is a procedure for ensuring access to all environmental laws and regulations applicable to the organizations 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. Legal and other requirements of the planning process includes any voluntary codes and principles (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

3.3.3 Objectives and Targets

ISO 14001 defines an environmental objective as an "overall goal, arising from the environmental policy that an organization sets itself to achieve, and which quantified wherever practical". Environmental targets are "detailed performance requirement, quantified wherever practicable, applicable to the organization or parts thereof, that arise from the environmental objectives and that need to be set and met in order to achieve those objectives" (Cascio, et all,1996).

Targets are specific performance requirements that must be accomplished to achieve an environmental objective. A target is a short-term goal that can be established to help a facility achieve long-term goals which are known as objectives. For example, an objective for facility may be reduce energy usage in a plant, one way to achieve this goal is to set targets that will help reduce operations processes that will lead to accomplishing the objective (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

3.3.4 Environmental Management Programs

The final element in the planning process is the development of specific management programs achieving the environmental objectives and targets. To be most effective the environmental action programs should be integrated into the organization's strategic plan. Environmental action programs should address schedules, resources and responsibilities for achieving the organization's environmental objectives and targets (Tekneci ,2004).

Environmental action programs help the organization to improve its environmental performance. They should be dynamic and revised regularly to reflect changes in organizational objectives and targets (Tekneci, 2004).

The creation and use of a program is a key element to the successful implementation of an environmental management system. The program should describe how the organization's targets will be achieved, including time-scales and personnel responsible for implementing the organization's environmental policy. The program should include an environmental review for all new activities (Tekneci, 2004).

3.4 EMS Implementation And Operation

The ISO 14001 standard identifies 7 specific elements in the Implementation and Operation component of an EMS. These elements are:

- Organizational Structure and Responsibilities
- Training, Awareness, and Competence
- Communication
- EMS Documentation
- Document Control

- Operational Control

3.4.1 Organizational Structure and Responsibilities

To meet the ISO 14001 EMS standard, a municipality or facility needs to have a documented organizational structure which identifies the roles and responsibilities for implementing and maintaining the EMS of top and middle management, and in other relevant functions and groups ((Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

Three specific tasks must be determined under the Structure and Responsibility section of the standard. First, the responsibilities of each individual and unit within the organization must be defined, documented and communicated with respect to operation of the environmental management system. Second, adequate resources must be provided to support the implementation and operation of the environmental management system. Third, a specific representative of management must be assigned who has the responsibility for ensuring that the overall environmental management system conforms to ISO 14001. That individual also must report on the performance of the system (Virginia Department of Environmental Quality, (n.d.)).

ISO 14001 does not provide any guidance with respect to the documentation requirement within this section. It is assumed that organizational charts that specifically highlight the responsibilities of each individual and unit within the organization with respect to the environmental management system will meet this requirement. The addition of detailed position and unit descriptions and responsibilities would be a very strong reinforcement to the organization charts (Virginia Department of Environmental Quality, (n.d.)).

Adequate resources must be provided to implement and maintain the environmental management system. Resources can be broken down into two basic categories:

manpower and technology. Management must provide the necessary workforce to implement and maintain the environmental management system. In addition that workforce must have the appropriate level of skills to support the effort. The technology resources will be dependent upon the targets that have been established. If the deployment of new technology is required to meet a target, then it must be provided (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 organization.s top decision-making group ((Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

3.4.2 Training, Awareness, and Competence

Training is a very important part of a successful ISO 14001 program. For the program to be successful, it is essential that all members of a facility contribute and participate in its implementation.

The organization must determine overall training needs required for competence with respect to the environmental management system.

Effective training programs, including those that raise the environmental awareness levels of all people in the organization, are a critically important element in implementing and maintaining the EMS. Depending on the nature of the operations, it may be necessary to raise the level of awareness of the facility's users (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

Training must be approached systematically:

✓ An environmental awareness training program must be implemented for employees covering the importance of the environmental policy and the requirements of the EMS, the significant environmental aspects of their work, their roles and responsibilities in carrying out the EMS, and the potential consequences of not following operating procedures. The environmental awareness training should be aimed at educating employees on how they can make a contribution to the EMS and to the facility's environmental performance.

✓ Identified environmental training needs should include the needs of each person whose work has existing or potential control over these impacts. Each of these individuals must meet a competency standard (developed by the municipality or facility) to be achieved through education, training or practical experience. As in the case of operational controls, the nature of training programs will depend on the scope and purpose of the EMS. Training programs developed for an individual facility will be very different than those developed for a community involving numerous actors that the municipality does not directly control. In either case however, training is the key to the success of an EMS (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

3.4.3 Communication

Internal and external communication is always a formal component of an EMS.

An internal communication program establishes regular exchange of information about environmental issues and opportunities, at all vertical management levels, as well as horizontally across operating units (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

An external communication program must, at a minimum, provide for a formal process for receiving, documenting and responding to complaints or enquiries from interested parties (e.g., community residents, government agencies, customers, suppliers) concerning the facility or municipality.s environmental aspects and its EMS (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

3.4.4 EMS Documentation

The core elements of the EMS must be documented. Core elements include the 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. 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).

The use of the word "document" in ISO 14001 provides a direct reference to what are the foundation elements of the environmental management system. Where is the word "document" used in the standard? (Virginia Department of Environmental Quality, (n.d.)).

USE OF THE WORD "DOCUMENT"	
1. **Environmental Management System Requirements**:	
Environmental Policy (4.2)	"documented"
2. **Planning**:	
Objectives and Targets (4.3.3)	"documented"
3. **Implementation and Operation**:	
Structure and Responsibility (4.4.1)	"documented"
Environmental Management System Documentation (4.4.4)	"documentation"
Document Control (4.4.5)	"document"
Operational Control (4.4.6)	"documented"
4. **Checking and Corrective Action**:	
Monitoring and Measurement (4.5.1)	"documented"
5. **Management Review** (4.6)	"documented"

Figure 3.2 EMS documentations

Where in the standard is there an "implied" requirement for documentation?

"IMPLIED" DOCUMENTATION	
1. **Planning**:	
Environmental Aspects (4.3.1)	"establish...procedures"
Legal and Other Require…(4.3.2)	"establish...procedures"
Environmental Management Programme(s) (4.3.4)	"establish…programme(s)"
2. **Implementation and Operation**:	
Training, Awareness and Competence (4.4.2)	"establish...procedures"
Communication (4.4.3)	"establish...procedures"
Emergency Preparedness And response (4.4.7)	"establish...procedures"
3. **Checking and Corrective Action**:	
Nonconformance and Corrective And Preventative Action (4.5.2)	"establish...procedures"
Records (4.5.3)	"establish...procedures"
Environmental Management System Audit (4.5.4)	"establish...programme(s)"

Figure 3.3 EMS Procedures

3.4.5 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).

Some specific tasks must be addressed under the Document Control section of the standard. *First*, the scope of the overall document control system needs to be defined. *Second*, within the control system there must be a document authorization or approval requirement. *Third*, the control system must maintain a revision tracking process. *Fourth*, the control system must be designed to ensure that the appropriate revisions are available at the workstations where they are employed. *Fifth*, out of date documents must be promptly removed from the workstation locations. *Sixth*, out of date documents that need to be archived for historical purposes need to be maintained in a separate location (Virginia Department of Environmental Quality, (n.d.)).

3.4.6 Operational Control

The EMS must provide for documented operational controls or procedures for each operation and activity associated with the identified significant environmental aspects. Operational controls or procedures must be devised to ensure that facility operations and activities are carried out minimize deviations from a facility's environmental policy and its environmental objectives and targets. Operational controls and procedures must specify operating criteria (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d)).

Operational control can be broken down into two plans: a technical control plan and a management control plan. These plans describe technical and management controls identified during the initial review/gap analysis. They may include budgets for internal capabilities, external support requirements, and actual expenditures for capital equipment. The plans can also quantify expected cost benefits derived from the improvements (Tekneci, 2004).

3.4.7 Emergency Preparedness and Response

The EMS is required to have an Emergency Preparedness and Response component. This component must include procedures for identifying potential accidents and emergency situations, proper responses, and measures to prevent and mitigate environmental impacts from accidents and emergency situations. For municipal facilities it is particularly important to consider how to work with the community in emergency situations (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

The Emergency Preparedness and Response plan or procedures must be reviewed and revised, when necessary, particularly after the occurrence of an accident or emergency. In addition, the procedures must be periodically tested where practicable (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

The emergency plans can include:

- emergency organization and responsibilities
- a list of key personnel
- details of emergency services (e.g. fire department, spill clean-up services)
- an internal and external communication plan

- actions taken in the event of different types of emergencies
- information on hazardous materials, including each material's potential impact
- on the environment, and measures to be taken in the event of accidental release;
- training plans and testing for effectiveness (Tekneci, 2004).

3.5 Checking and Corrective Action

In the ISO 14001 standard the checking and corrective action phase of the standard follows the development of the environmental policy statement, the planning phase and the implementation phase. This overall section of the standard discusses the necessary elements of the checking and corrective action process of the environmental management system. This section of the standard contains four distinct elements:

- Monitoring and Measuring
- Nonconformance and Corrective and Preventative Action
- Records
- Environmental Management System Audit

(Virginia Department of Environmental Quality, (n.d.)).

3.5.1 Monitoring and Measurement

Monitoring and measurement are required elements in an EMS. It is throught monitoring and measurement that an organization can assess its progress in meeting stated environmental objectives and targets. A monitoring and measurement program is a continuous process that includes ongoing data collection and continual tracking of specified parameters (Cascio, et all,1996).

This component must meet the following specific requirements:

- Documented procedures for regularly monitoring and measuring the key characteristics of municipal or facility operations and activities that can have significant environmental impacts.

- Documented procedures for tracking and recording information on performance, on relevant operational controls, and on progress toward the facility's environmental objectives and targets.

- Procedures for calibration and maintenance of monitoring equipment and retention of records.

- Documented procedures for periodically evaluating the facility's compliance with applicable environmental laws and regulations.

In designing performance indicators it is necessary to link them to specific objectives or targets so that they will provide practical data for corrective action to meet the organization's environmental commitments (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

3.5.2 Non-Conformance, Corrective, and Preventive Action

ISO 14001 requires an organization to establish and maintain procedures for handling, investigating, and initiating corrective and preventive action for non-conformance. In addition, responsibility and authority for all activities related to non-conformance must be defined (Cascio, et all,1996).

These procedures must also ensure that corrective and preventive actions to eliminate causes of actual or potential non-conformance are appropriate to the magnitude of the task and commensurate with the environmental impacts encountered (Best Practices

Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

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

communicate the changed procedure to the necessary activities within the system (Virginia Department of Environmental Quality, (n.d.)).

3.5.3 Records

The facility's EMS must have procedures for identifying, maintaining, and disposing of environmental records. The environmental records management process must ensure that records are legible, identifiable, and traceable to the activity, product or service involved (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

The purpose of this section of the standard is to ensure that the organization maintains in an organized fashion all the necessary documentation that is required by ISO 14001.

This section of the standard specifically references training records, audits results, and results of reviews. The records retention system should focus on a larger universe of documents:

- legal and other requirements,
- permits,
- environmental aspects and impacts,
- environmental training

- inspection and calibration information,
- monitoring data,
- nonconformance reports and follow-up information,
- environmental audits,
- management reviews,

emergency preparedness response information (Virginia Department of Environmental Quality, (n.d.)).

The content of the records retention system must be able to support and verify the operation of the environmental management system. The organization must establish a retention time frame for the records. Records from permit activities all ready have retention time frames established by regulatory groups. One additional suggestion would be to maintain records related to a previous nonconformance with the environmental management system for a longer time frame than other records. In addition the record retention system should be indexed and archived in such a manner that any searches can be accurately and quickly completed. The records that support the environmental management system are extremely important to the organization with respect to audits and management reviews (Virginia Department of Environmental Quality, (n.d.)).

3.5.4 EMS Audit

ISO 14001 defines an environmental management sytem audits as “a systematic and documented verification process to objectively obtain and evaluate evidence to determine whether an organization’s environmental management sytem conforms to the EMS audit criteria set by the organization, and communicate the results of this process to management (Cascio, et all,1996).

The audit program procedures must cover:

- scope of the EMS audit

- frequency/schedule of audits
- audit methodologies
- the responsibilities and requirements for conducting the EMS audit and for reporting the results to the facility's management (Best Practices Guide: Application of ISO 14000 Environmental Management Systems for Municipalities (n.d).

The EMS audit must focus on priorities such as the degree of risk of specific operations and activities and the results of previous audits.

The audit process discussed in this section of the standard is directed at internal audits. Generally accepted practice with a mature ISO 14001 system is a total audit of the system once a year. In the implementation phase of an environmental management system a more frequent audit process might be appropriate (Virginia Department of Environmental Quality, (n.d.)).

3.6 Management Review

The municipality or facility's EMS must provide for periodic review of the EMS by top management. Management review provides the nexus for an organization's environmental policy, long-term goals, environmental results, and continual improvement.

The EMS must ensure that needed information is compiled to allow for a proper management review. The information includes:

- Previous management review and audits results
- Environmental objectives and targets versus performance results
- Changes in business environment that may influence policy, objectives, and targets

- New or changed legislation
- New or changed stakeholder or interesed-party expectations
- Changes in applicable technology, including work processes
- Organization's financial and competitive position
- Business area and activities
- Market preferences
- Environmental incident, non-conformances and corrective action

This audit and review will only be effective if the participants have the expertise outlined in ISO 14012 for EMS auditors (Tekneci, 2004).

CHAPTER FOUR
PRESENTATION OF THE IRON AND STEEL INDUSTRY AND THE STUDY AREA

4.1 Iron and Steel Industry

4.1.1 Sector Definition

This sector covers the manufacturing of steel in basic shapes and forms that then can be used to create products. The sector is divided into two basic types of production; from raw materials - iron ore, limestone and coke by the blast furnace and basic oxygen furnace route or from scrap via the electric arc furnace (EAF) method. The raw material approach is known as the integrated route and about 60% of steel produced today is made by this method. The second technique is much easier and faster since it only requires scrap steel. Recycled steel is introduced into a furnace and re-melted along with some other additions to produce the end product. About 34% of steel produced in 2003 was produced via the EAF route (International Iron and Steel Institute, (n.d.))

In an EAF, the input material is primarily scrap steel, which is melted and refined by passing an electric current from the electrodes through the scrap (Environmental Protection Agency, (n.d.)).

4.1.2 Steel Industry Overview in the World

Steel is produced in more than 50 countries worldwide and on every continent except Antarctica. In 2003, more than 960 million metric tonnes of steel was produced worldwide (International Iron and Steel Institute, (n.d.)).

In 2003, China produced more than 220 million tons of machine steel making it the first country to exceed 200 million tons of machine steel in a year (International Iron and Steel Institute, (n.d.)).

In 2002, Japan exported more than 35.2 million tons of steel, a gain for the sixth consecutive year. By country, exports to South Korea, the largest single user of Japanese steel, totalled 9.20 million tons, a record high volume, with increases in flat-rolled products such as hot-rolled wide strips and plates. By product type, machine steel represented 70.9% of all Japanese steel exports in 2002 with special steel accounting for 14.1% (International Iron and Steel Institute, (n.d.)).

In 2002, the United States imported more than 30.2 million tons of steel and China imported 29.2 million tons of steel. More than 20% of the world's steel is produced in China and the country consumes more than one fifth of the world's steel production (International Iron and Steel Institute, (n.d.)).

4.1.3 Steel Industry Overview in the Turkey

Turkish iron and steel sector, the base of which was established in the 1930's, plays an important role in the industrialization and development of Turkish economy.

In July 1996, as a result of the agreement that Turkey signed with the European Coal and Steel Community (ECSC), elimination of customs duties mutually on steel trade, contributed to the development of the steel trade between Turkey and EU.

In the year 2001, in terms of production processes, 65% of the total production is realized by Electric Arc Furnaces and the remaining 35% by Integrated Facilities.

The Turkish iron and steel industry, has shown great progress in the last fifteen years, both in terms of quality and capacity and has been one of the growing iron and steel industries in the world. Currently, Turkish iron and steel sector ranks 15th among the 64 steel-making countries in the world and 5th in Europe. According to statistics of the year 2001, the share of EU, Middle East countries and Far East countries in the total iron and steel exports of 9.5 million tons are 28%, 26% and 16% respectively. (Middle East Steel, (n.d.)).

4.1.4 Recycling

Recycled iron and steel scrap is a vital raw material for the production of new steel and cast iron products. Recycling of scrap plays an important role in the conservation of energy because the remelting of scrap requires much less energy than the production of iron or steel products from iron ore. Also, consumption of iron and steel scrap by remelting reduces the burden on landfill disposal facilities and prevents the accumulation of abandoned steel products in the environment. Recycled scrap consists of approximately 28% home scrap (recirculating scrap from current operations), 23% prompt scrap (produced in steel-product manufacturing plants), and 49% post-consumer (old) scrap (Fenton, 2004).

Of the 960 million tons of steel produced in 2003, more than 60% of it was produced from recycled steel (International Iron and Steel Institute, (n.d.)).

Recycling listed eight categories of benefits from recycling, all applicable to steel:

- Reduces the need for new landfills
- Prevents emissions of many air and water pollutants
- Saves energy
- Supplies valuable raw materials to industry
- Creates jobs
- Reduces greenhouse gas emissions
- Stimulates the development of greener technologies
- Conserves resources for our children's future (Steel Manufacturers Association, (n.d.)).

4.2. Process of Factory

4.2.1 Introduction of Factory

The factory was established in 1975. The modern rolling mill was inaugurated in 1983 and melt shop equipped with the latest modern technologies was commenced in 1987. The plant is located on 500.000 square meter area at Aliağa Region.

The plant's layout is designed to provide optimum material flow between the units in accordance with in the concept: "from scrap to product".

The plant has approximate 550 personnel who are qualified in their field. With strong shareholders' equity and financial structure, the factory has become one of the leading producers and exporters of Turkey.

4.2.2 Process of Factory

- Melt shop
- Rolling Mill
- Auxiliaries

- **MELTSHOP**

The plant's melt shop which has 850.000 tons/y capacity incorporates all of the technological superiorities existing in the World and is operated with high productivity and efficiency.

Scrap Yard

Iron scrap, which mostly comes from abroad, is used as the basic raw material. The scrap that comes to the pier at Nemrut Bay by ships has transported to the scrap yard by trucks and stocked there.

Electric Arc Furnace (E.A.F)

The scrap, which is loaded 72 MVA powered electric arc furnace that has the tapping weight of 85 tons by overhead crane charged, is becoming liquid by melting them with the high temperature caused by the change; into an E.A.F at the end of the electrode. The process has been accelerated by giving pure oxygen and powder carbon into the furnace during the melting process.

Ladle Furnace

Liquid steel, which is obtained from the melt-shop, is taken to the ladle furnace after taking them to the ladles. Later the alloy element is made here for the required production standards for appropriate steel.

Continuous Casting Machine

Steel transport from the ladle furnace with ladles to bring continuous casting machine which is existed with speed controlled and cooled system. It is poured water cooled mould to cool and cut distinct length according customer request. Then it is forwarded cooling bed.

Cooling Bed

Billets, which are hotter than 700°C at their cooled condition are cooled packed and labelled at the bed and are sent to the stock yard.

Billet Stock Yard

The packed and prepared billets are stowed appropriately in the stock stow area and are held ready for the dispatch of the port.

➢ ROLLING MILL

The factory's rolling mill has 680.000 tons/y capacities. Production in rolling mill is entirely computer controlled.

Reheating Furnace

The reheating furnace, which has the capacity of 100 tons/hour, insreases the efficiency of burning and also provide energy saving by the automation system it has.

Roughing Stands

8 units of rolling - mill stands between the exit of the reheating furnace and the finish stands forms the preparation group. The billet, which comes out of the reheating furnace here, is prepared at required sizes at the entrance.

Finishing Stands

8 units of rolling-mill stands which come after the roughing stands form this group. Here the last shape is given to the product according to the international steel bars standard requirements. The products are sent to the cooling bed from here.

Sliting Process

The factory has slit rolling and double slit rolling systems. By using this system, more production can be realised.

Thermex Process

This process makes temperit by cooling the hot production with cold water and it gives high tensile and weldabilty.

Cooling Bed

The products produced are cooled cooling beds. Then products are send to the packing unit after they are cut according to the requirements of the customers.

Bundleds Machine

The products, which are packed by the full automatic bundless machine which can make strict programed ties and lifting rings, are made ready to be sent out.

Stock Yard

The products which are packed in the packing section are stowed according to the diameters and customers and are stored for the sale.

- **AUXILIARIES**

Dust Collection System

There are dust collection units two numbers in the factory. Total capacity of system factory is 1.200.000 m^3/hour.

Dust Collection lines;

- Direct Suction Line
- Roof Suction Line
- Ladle furnace suction line

Preparation Usage Water System

The factory prepares and improves the water it needs and it represents it as a closed circuit to use in the company.

Oxygen Plant

The factory realized the production oxygen, argon and nitrogen gases it uses at its own structured plants and with this aim, it has formed pure oxygen producing plant.

The workflow of glass recovery factory is shown in Figure 4.1 and Figure 4.2.

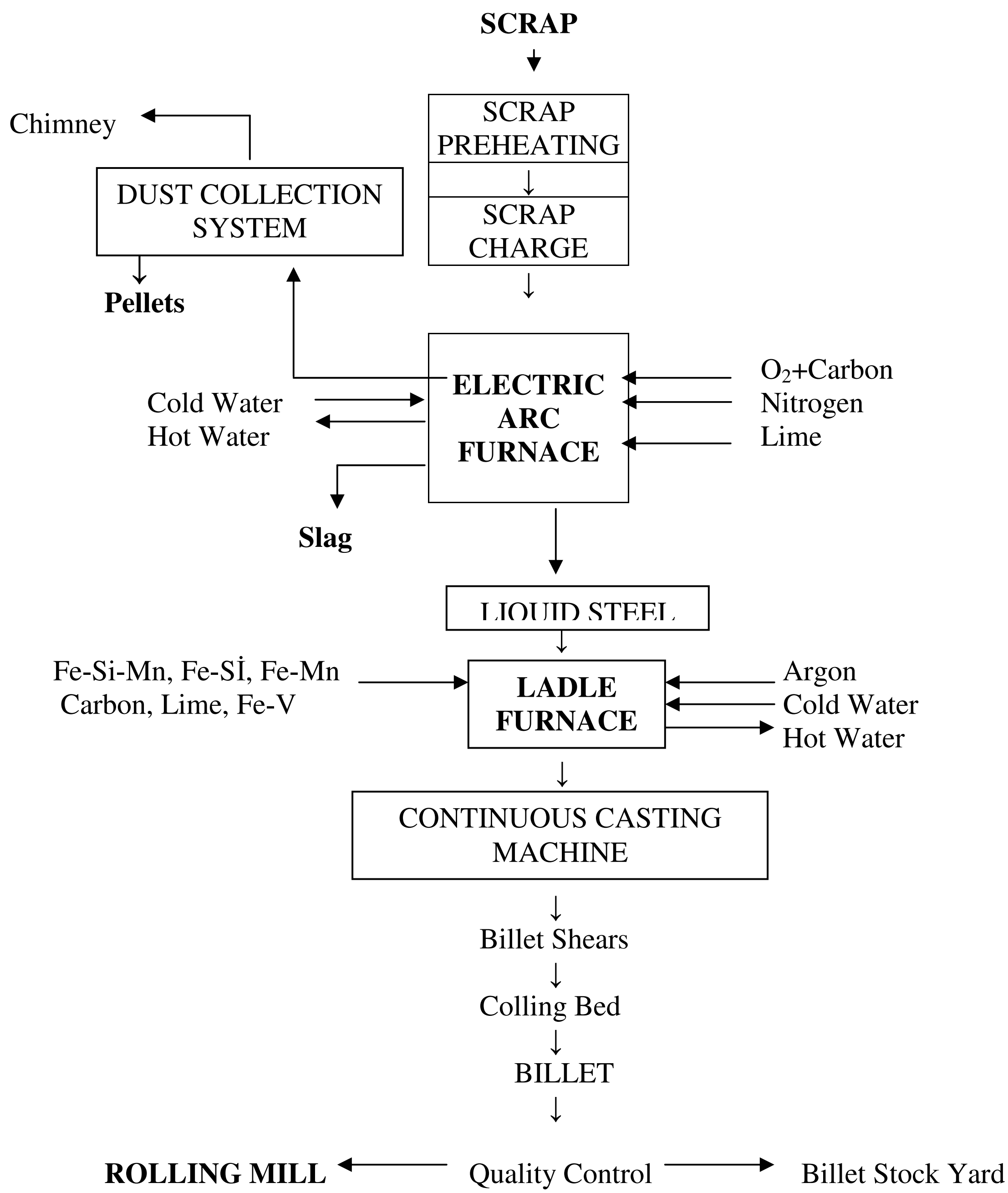

Figure 4.1 Meltshop Process Diagram

BILLET

↓

Cold Water → Preheating Furnace → Hot Water

↓

Cold Water → Roughing Stands → Hot Water

↓

Cold Water → Finishing Stands → Hot Water

↓

Sliting Process

↓

Cooling Bed

↓

Bundless Machine

↓

Stock Yard

Figure 4.2 Rolling Mill Process Diagram

CHAPTER FIVE
CASE STUDY: APPLICATION OF ISO14000 EMS IN AN IRON AND STEEL FACTORY

5.1 Environmental Management System at Iron and Steel Industry

The basic and the absolute requirement for obtaining ISO14001 certificate is the willingness of the factory management for obtaining better environmental approaches and technologies during the operational period. The second step is to spread out this willingness among all the enginners and the workers present in the facility.

Initial environmental review should be done by the factory managemet and then the steps of ISO14001 application need to be applied by all staff from the top to bottom.

Here, the iron and steel factory introduced in the previous chapter is accepted as a candidate and volunteer for obtaining ISO14001 certificate. The initial environmental review has done by the author during a three months period by working in the facility and observing and searching the environmental impacts. The possible technics and directives are presented in different scenarios to overcome the environmental handicaps and they are discussed.

5.2 Initial Environmental Review

Initial review is very important to determine present environmental situation of the factory. At the initial review section the below subjects are considered;

- Determine necessities of the facility according to the laws and regulations
- Determine positive or negative environmental aspects of facilty

- Determine environmental accidents, incidents, non-legality and punishment in the past

5.2.1 Present Situation of Factory -The Results of Initial Environmental Review

The findings of the initial review are given below. The negative (-) and positive (+) signs in the pharantesis following each phrase means if the finding needs a corrective action or not.

1. Environmental Impact Assessment (EIA) of the facility is not present since the facility has established before the publication of related legal directives. (+)
2. As a result of not having EIA; the factory has not permission as a Non-Sanitary Enterprises which should be taken from the municipality. (+)
3. Discharge Permission Certificate of the facility exists. According to Discharge Permission Certificate; outlet water from the wastewater treatment plant has discharged to the garden of the factory as irrigation water. (-)
4. There is not membership system in the factory for following the new legislations or the updated directives. (+)
5. Fire events frequently happen in the factory (+)
6. Flood event occurred twice in the past. (+)
7. R22 is used as cooler gas in the factory. (+)
8. Material Safety Data Sheets (MSDS) of materials, which are used in the factory, do not exist. MSDSs are very important for preparing emergency situation action plans.(+)
9. Medical wastes are not disposed according to Medical Waste Control Regulation. (+)
10. A responsible person with environmental problems in the factory does not exist.(+)

11. Temporary storage area does not exist in the factory, but a study is initialized for solving this problem. (+)
12. Drinking and cooling water is obtained from three groundwater wells around the factory. The well water level measurements are made once in every three months and records are kept. (-)
13. Slag, which is the most important solid waste of the factory, is stored as piles in the back side of the factory. (+)
14. Wastewater treatment plant is operated for only domestic wastewater. In the factory, there is not industrial wastewater treatment plant. However, process wastewater includes oil and grease. (+)
15. Sludge, which is generated from wastewater treatment plant, is stored in the same area with slag waste. (+)
16. There is no noise measurement and control in the factory. (+)
17. Steel scrap, which is used for steel production, may contain radioactive material. Scraps are investigated with towards radioactive equipment before consigning scrap yard. (+)
18. Oil barrels are burned as scrap in electrical arc furnace. (+)
19. Flue gas emission measurement is made periodically. But Emission Permission Certificate does not exist. (+)

As can be seen from the list 17 out of 19 reviews are needed to be corrected with by actions.

5.3 Environmental Politics of the Facility

The facilty has not had any environmental politcs since it was established. The environmental politics of the discussed iron and steel factory, according to ISO14001 and opportunities of the facilty, is formed in this part of the study.

The Company, with its management and all employees, aims at performing all its product, production and service activities in every stage of production from the product design to supply in accordance with the principle of sustainable development.

The formed environmental policy of iron and steel factory is shown in Figure 5.1.

Environmental Policy

The top management of the factory commits the subjects below,

- Improve constantly our environmental performance and to ensure compliance with all the legal and other obligations,
- Decrease the amount of wastes and keep under control and minimize their impacts on environment.
- Minimize the utilization of energy and other natural resources motivating and supporting activation of efficiencient consumption, recycling and reevaluation techniques.
- Raise general environmental awareness of employees and suppliers by training and encouraging related activities
- Utilize recyclable raw materials and technologies having less environmental impact in the production phases of products and processes
- Provide continual improvement and make realize effective environmental management system

General Management

Figure 5.1 Iron and Steel Factory environmental policy

5.4 Planning

5.4.1 Environmental Aspects & Impacts

After the present environmental condition has been determined, environmental aspect determination form has to be prepared. At the iron and steel factory, the environmental impacts are considered under the topics of legal requirements, past problems, informational defects, use of environmental resources and then an environmental impact evaluation forms is established.

While the environmental impact evaluation form is established the probability and effect scores are determined for each environmental aspect and the risk scores are calculated. The scoring method is obtained from Turkish Standard Institution (2004). ISO 14000 EMS publication. Occuring probability scores explain the risks of each aspects, it rises with increasing risks. Prevention probability scores explain the availability to stop that risk and the scores incresases with decreasing availability. Dose of effect scores represent the intensity of the aspect in the facilty if it happens.

Table 5.1 Risk Scores

Occuring Probability	**Prevention Probability**	**Dose of Effect**
5: very high probability	0: certainly prevention	0: no effect
4: high probability	1: very high probability	2: minor effect
3: average probability	2: high probability	4: low effect
2: low probability	3: average probability	6: average effect
1: very low probability	4: low probability	8: high effect
0: no occuring probability	5: very low probability	10: major effect

Two different environmental aspect determination approach for of iron and steel factory are given in the Tables 5.2 and 5.3. The approaches are used to build different scenarios for solving the environmental problems of the facility. In the first scenario the scores of occurring probability and prevention probability are added and the result is multiplied by the dose of effect to calculate the environmental effect value. In the second scenario the occurring probability score is multiplied by the score of prevention probability score and then the result is multiplied by dose of effect score to calculate the environmental effect value. The tables of related scenarios are given as follows.

Table 5.2. Environmental Effect Values of Environmental Aspects- Scenario I

ENVIRONMENTAL IMPACT INVENTORY

NO	Environmental Aspect	Environmental Risk	Occuring Probability A	Prevantion Probability B	Dose of Effect C	Environmental Effect Value (A+B)*C
1	Slag Storage	Water,soil and air pollution	5	5	10	**100**
2	Carbondioxide amount	Soil and air pollution, use of natural resources	5	5	10	**100**
3	Fire	Water,soil and air pollution	5	3	10	**80**
4	Flood	Water,soil and air pollution	4	4	10	**80**
5	R22 tubes	Soil and air pollution	5	3	10	**80**
6	Machine oil usage	Water,soil,air and noise pollution,use of natural resources	5	5	8	**80**
7	Noise from working machines	Noise pollution	5	5	8	**80**
8	Repair of machinary	Water,soil,air and noise pollution,use of natural resources	5	4	8	**72**
9	Exhaust emission	Use of natural resources, air pollution	5	4	8	**72**
10	Usage of underground water	consumption of natural resources	5	4	8	**72**

11	Flue gas emissions	Soil and air pollution	5	4	8	**72**
12	Radioactive scrap	Water and soil pollution, human healty	5	2	10	**70**
13	Process wastewater	Water and soil pollution	5	3	8	**64**
14	Storage of treatement sludge	Water,soil and air pollution	5	3	8	**64**
15	Discharge of treated water	Use of natural resources,water and air pollution	5	3	8	**64**
16	Earthquake	Water,soil and air pollution	1	5	10	**60**
17	Wastewater treatment system process desruption	Water, soil and air pollution	4	3	8	**56**
18	Medical waste	Water and soil pollution, human healty	4	2	8	**48**
19	Vehicle accidents in factory	Water,soil and air pollution	3	2	8	**40**

Table 5.3. Environmental Effect Values of Environmental Aspects - Scenario II

ENVIRONMENTAL IMPACT INVENTORY

NO	Environmental Aspect	Environmental Risk	Occuring Probability A	Prevantion Probability B	Dose of Effect C	Environmental Effect Value (A*B)*C
1	Slag Storage	Water,soil and air pollution	5	5	10	**250**
2	Carbondioxide amount	Soil and air pollution, use of natural resources	5	5	10	**250**
3	Fire	Water,soil and air pollution	5	3	10	**150**
4	Flood	Water,soil and air pollution	4	4	10	**160**
5	R22 tubes	Soil and air pollution	5	3	10	**150**
6	Machine oil usage	Water,soil,air and noise pollution,use of natural resources	5	5	8	**200**
7	Noise from working machines	Noise pollution	5	5	8	**200**
8	Repair of machinary	Water,soil,air and noise pollution,use of natural resources	5	4	8	**160**
9	Exhaust emission	Use of natural resources, air pollution	5	4	8	**160**

10	Usage of underground water	consumption of natural resources	5	4	8	**160**
11	Flue gas emissions	Soil and air pollution	5	4	8	**160**
12	Radioactive scrap	Water and soil pollution, human healty	5	2	10	**100**
13	Process wastewater	Water and soil pollution	5	3	8	**120**
14	Storage of treatement sludge	Water,soil and air pollution	5	3	8	**120**
15	Discharge of treated water	Use of natural resources,water and air pollution	5	3	8	**120**
16	Earthquake	Water,soil and air pollution	1	5	10	**50**
17	Wastewater treatment system process desruption	Water, soil and air pollution	4	3	8	**96**
18	Medical waste	Water and soil pollution, human healty	4	2	8	**64**
19	Vehicle accidents in factory	Water,soil and air pollution	3	2	8	**48**

5.4.2 Legal Requirements

The legal requirements that the facilty should carry out are considered in this part of the study. In Table 5.4 the publishment date and number of the Official Gazette are given for the regulations and directives that should be performed by the facility.

Table 5.4 Regulations to be performed by Iron and Steel Industry

NO	LAW / REGULATIONS	O.G. NO	DATE OF PUBLISHMENT
1	Environmental Law	2872	11.08.1983
2	Air Quality Protection Regulation	19269	02.11.1986
3	Noise Control Regulation	19308	11.12.1986
4	Water Pollution Control Regulation	25687	31.12.2004
5	Solid Waste Control Regulation	20814	14.03.1991
6	Medical Waste Control Regulation	21586	20.05.1993
7	Hazardous Chemical Medical and Product Control Regulation	21634	11.07.1993
8	Hazardous Waste Control Regulation	25755	14.03.2005
9	Regulation on Non-sanitary Enterprises	22416	26.09.1995
10	Environmental Impact Assessment Regulation	24777	06.06.2002
11	Soil Pollution Control Regulation	24609	10.12.2001
12	Environmental Auditing Regulation	24631	05.01.2002
13	Waste Oil Control Regulation	25353	21.01.2004
14	Industrial Air Pollution Control Regulation	25606	07.10.2004
15	Package and Package Waste Control Regulation	25538	30.07.2004
16	Waste Battery and Accumulators Control Regulation	25569	31.08.2004

Environmental legislation must be followed by the Environmental Representative in the factory for better understanding and appropriate application.

The environmental objectives and targets of the facility are determined after the compharison of two different scenarios and are presented in Chapter 7.

CHAPTER SIX
EXPERIMENTAL STUDY

In this section sampling of iron and steel slag, the methods used in laboratory experiments completed by using iron and steel slag, the results of the experiments, and the discussion of the results are given.

6.1 Sampling and Preparation of Experimental Setup

In this study, the effect of slag addition on concrete's compressive strength is investigated. The slag is obtained from electric arc furnace of an iron and steel production facility which is operated in İzmir. Two set of experiments are conducted. Slag is replaced in the ratio of %10, %20, and %40 with cement or sand during concrete mix preparation. Control samples are prepared with no slag addition. The measurements of mortar samples are 5cm*5cm*5cm.. Prepared examples are allowed to wait in water. The compressive strengths of the sample blocks are measured in 7th, 28th and 96th days of the experimental period. The experiments with cement replacement are triplacated and the experiments with sand replacement are duplicated. The results compared with the controls. Totally 54 samples are used for the study.

When mortar mixture prepared, dry sand, PC 42,5 cement and tap water are used. In Table 6.1 and Table 6.2 the amount of the materials used for mortar mixtures are given.

Table 6.1 Sand replacement

Sample	**Sand**		**Cement**		**Slag**		**Water**
	(gr)	***(%)***	**(gr)**	***(%)***	**(gr)**	***(%)***	**(ml)**
Control Sample	1350	*75*	450	*25*	-	*0*	225
%10 Slag	1215	*67,5*	450	*25*	135	*7,5*	225
%20 Slag	1080	*60*	450	*25*	270	*15*	225
%40 Slag	810	*45*	450	*25*	540	*30*	225

Table 6.2 Cement replacement

Sample	**Sand**		**Cement**		**Slag**		**Water**
	(gr)	***(%)***	**(gr)**	***(%)***	**(gr)**	***(%)***	**(ml)**
Control Sample	1350	*75*	450	*25*	-	*0*	225
%10 Slag	1350	*75*	405	*22,5*	45	*2,5*	225
%20 Slag	1350	*75*	360	*20*	90	*5*	225
%40 Slag	1350	*75*	270	*15*	180	*10*	225

6.2 Laboratory Methods Used

6.2.1 Heavy Metals Determination (Total Acid Digestion)

To determine the total heavy metal content of the bulk samples, Acid Digestion Procedure (EPA 3050 B) is applied to dry bulk samples. For the digestion of the samples, 1 gram of (dry weight) sample was digested with repeated additions of nitric acid (HNO_3) and hydrogen peroxide (%30 H_2O_2). The digestate was then reduced in volume and refluxed in concentrated hydrochloric acid (HCl). The extracts were then diluted and filtered through 125 µm filter paper.

Nickel and lead concentrations were measured in Merck Nova 60 Photometer by using reagent tests; copper and zinc were measured by using cell tests.

6.2.2 Tessier Extraction of Heavy Metals

Procedures for sequential chemical extractions have been developed for the partitioning of particulate trace metals into several fractions. These fractions are;

Exchangable . Metals extracted during this step are those which are weakly absorbedand retained on the sediment surface by relatively weak electrostatic interaction and metals that can be released by ion-exchange processes (Dean J.R.).

Bound to carbonates . These metals can be co-precipitated with the carbonates present in many sediments. This fraction is easily effected by pH changes (Tessier A., Campbell P.G.C., Bisson M., 1979). The exchangeable and bound to carbonates fractions are loosely bound and labile materials and these are most available for plant uptake (Dean J.R.).

Reducible . These are the metals bound to iron/manganese oxides and they are unstable under reducing conditions. Changes in redox potential induce the dissolution of these oxides and release absorbed trace metals (Dean J.R.).

Oxidizable . These are the metals bound to organic matter . The degredation of organic matter under oxidizing conditions can lead to a release of soluble trace metals bound to this component. Trace metals bound to sulfides might be extracted during this step (Dean J.R.).

Residual. These are the metals bound within the cyristal matrix and they are not expected to be released under normal conditions in nature.

Sequential Extraction Studies

To determine these five fractions mentioned above, a combination of Tessier protocol (Dean J.R.) and BCR Extraction procedure (Rauret G., Lopez-Sanchez J.F., SAhuquillo A., Rubio R., Davidson C., Ure A., 1999; Morrison H., Vicente Beckett V.) were applied to the samples collected from iron and steel industry.

(i) ***Fraction 1, Exchangable****;* 1 gram of air-dried slag was extracted at room temperature for 1 hour with 8 ml of magnesium chloride solution (1 M $MgCl_2.6H_2O$) with continuous agitation. (80 rpm, in shaking incubator). The samples were then centrifuged at 2500 rpm for 30 minutes, the supernatant was carefully removed to a test tube to analyze the exchangeable forms of metal concentrations. The residue was washed with 8 ml of pure water; the sample was centrifuged as above, this second supernatant was carefully removed and discarded.

(ii) ***Fraction 2, Bound to Carbonates;*** The residual from ***(i)*** was extracted with 40 ml of 0.11 molar acetic acid in shaking incubator at 80 rpm for 16 hours. The samples were then centrifuged at 2500 rpm for 30 minutes; the supernatant was carefully removed to a test tube to analyze the *bound to carbonates* fraction of metal concentrations. 20 ml of pure water was used to wash the samples and centrifuged as above.

(iii) ***Bound to Iron-Manganese Oxides;*** A volume of 40 ml of 0.5 M hydroxylamine hydrochloride (acidified with 2 M HNO_3 to pH 2) was added to each tube and the process of shaking, centrifugation and washing was repeated. The supernatant analyses gave the reducible form of the metal concentrations.

(iv) ***Bound to Organic Matter;*** In this fourth step of the procedure, 10 ml of hydrogen peroxide (%30 H_2O_2) was added to each sample and the samples were left to stand at room temperature for 1 hour, and then placed into a water bath at 85 ^{0}C for a further hour. Then the peroxide was evaporated to reduce the volume to about 1 ml. A further 10 ml of hydrogen peroxide was added and left in water bath for another 1 hour and peroxide was evaporated again to near dryness. After cooling the samples, 50 ml of ammonium acetate (acidified to pH 2 with HNO_3) was added to each tube and the shaking, centrifugation and washing process described above was repeated.

(v) ***Residual.*** The difference between the total metal concentration and the sum of the four fractions mentioned above gave the metals found in residual fraction .

The “selective” extractions were conducted in 50 ml polypropylene centrifuge tubes to prevent or minimize losses of solid material.

6.2.3 Determination of Compressive Strength of the Concrete Blocks

The determination of compressive strengths of the concrete blocks is completed in Civil Engineering Department of Dokuz Eylül University. A device of Elle Autotest 3000 is used for the experiments.

CHAPTER SEVEN
RESULTS AND DISCUSSION

In this section, the results of the experimental studies and the discussion of the findings during the study phase are presented.

7.1 Results of the Experimental Studies

7.1.1 Total Heavy Metal Content of Iron and Steel Slag

Total concentrations of the heavy metals present in iron and steel slag is given in Table 7.1.

Table 7.1. Total heavy metals content of iron and steel slag

Concentration	**Heavy Metals**				
	Cr	**Cu**	**Ni**	**Pb**	**Zn**
ppm, dry weight	4890	350	5	45	75

7.1.2 Distribution of Heavy Metals in Iron and Steel Slag According to the Tessier Extraction

The concentration of heavy metals present in iron and steel slag in different forms are shown in Table 7.2.

Table 7.2. The distribution of heavy metals in iron and steel slag according to their forms

Concentration, ppm dry weight / Form of the Metal	**Heavy Metals**				
	Cr	**Cu**	**Ni**	**Pb**	**Zn**
Exchangable	0,27	1,58	0	0,35	0
Bound to Carbonates	8,08	1,96	0	2,44	8,68
Bound to Mn-Fe Oxides	14,2	184,88	0,64	5,52	12,64
Bound to Organics	191,30	99,35	0,85	4,00	8,70
Residual	4676,15	62,03	3,51	32,69	44,98

7.1.3 Compressive Strength of the Concrete Blocks

In this part, the compressive strengths of the mortar blocks are presented. The results are summarized in two tables, one for the results of the experiments completed with sand replacement (Table 7.3) and one for the result of the experiments with cement replacement (Table 7.4).

Table 7.3. Compressive strength of the concrate blocks- slag replaced with sand

Samples	**7th Day**		**28th Day**		**96th Day**	
	kg/cm^2	**kgf**	**kg/cm^2**	**kgf**	**kg/cm^2**	**kgf**
Control 1	358,6	8960	402,3	10060	491,8	12290
Control 2	313,7	7840	414,3	10360	491,6	12290
Control 3	329,3	8230	400,3	10010	484	12100
Average	***333,9***	***8343,3***	***405,6***	***10143,3***	***489,1***	***12226,7***
stdv	22,8	568,5	7,6	189,3	4,4	109,7
%10 slag 1	418	10450	488,3	12210	552,7	13820
%10 slag 2	392,2	9810	481,4	12040	470,6	11760
Average	***405,1***	***10130***	***484,85***	***12125***	***511,65***	***12790***
stdv	18,24335	452,5483	4,879037	120,2082	58,05347	1456,64
%20 slag 1	385,2	9630	468,1	11700	570	14250
%20 slag 2	422,3	10560	446,2	11150	547,2	13680
Average	***403,75***	***10095***	***457,15***	***11425***	***558,6***	***13965***
stdv	26,23366	657,6093	15,48564	388,9087	16,12203	403,0509
%40 slag 1	435,7	10890	526,6	13160	584,8	14620
%40 slag 2	457,8	11450	504,6	12620	623,6	15560
Average	***446,75***	***11170***	***515,6***	***12890***	***604,2***	***15090***
stdv	15,62706	395,9798	15,55635	381,8377	27,43574	664,6804

Table 7.4. Compressive strength of the concrate blocks- slag replaced with cement

Samples	**7. Day**		**28. Day**		**96. Day**	
	kg/cm^2	kgf	kg/cm^2	kgf	kg/cm^2	kgf
Control 1	358,6	8960	402,3	10060	491,8	12290
Control 2	313,7	7840	414,3	10360	491,6	12290
Control 3	329,3	8230	400,3	10010	484	12100
Average	***333,9***	***8343,3***	***405,6***	***10143,3***	***489,1***	***12226,7***
stdv	22,8	568,5	7,6	189,3	4,4	109,7
%10 slag 1	267,3	6680	328	8200	430,2	10750
%10 slag 2	272,2	6810	373	9430	430,3	10760
%10 slag 3	268,1	6700	334,9	8370	429,5	10740
Average	***269,2***	***6730,0***	***345,3***	***8666,7***	***430,0***	***10750,0***
stdv	2,6	70,0	24,2	666,5	0,4	10,0
%20 slag 1	239,8	5990	301,9	7550	420,3	10150
%20 slag 2	203,5	5030	307	7680	405,2	10130
%20 slag 3	218,6	5460	241,4	6030	406,7	10170
Average	***220,6***	***5493,3***	***283,4***	***7086,7***	***410,7***	***10150,0***
stdv	18,2	480,9	36,5	917,4	8,3	20,0
%40 slag 1	157,8	3950	206,2	13160	338,1	8450
%40 slag 2	146,1	3650	228,8	12620	315,4	7890
%40 slag 3	152,7	3820	222,5	5560	342,1	8550
Average	***152,2***	***3806,7***	***219,2***	***10446,7***	***331,9***	***8296,7***
stdv	5,9	150,4	11,7	4240,6	14,4	355,7

7.2. Discussion of the Results

Discussion of the results will be given in two parts: discussion of the experimental results and the discussion of waste management studies of the facility.

7.2.1 Discussion of the Experimental Results

As can be seen in Table 7.1 Chromium (Cr) and Copper (Cu) content of iron and steel slag is significantly high, which are 4890 ppm, and 350 ppm, respectively. The limit values of those metals in the soil are 100 ppm and 50 ppm for the pH value of less then 6 and 100 ppm and 140 ppm for pH value of higher then 6 in the Directive for Soil Pollition and Control (Solid Waste Control Regulation,O.G No:20814, Date of Puplishment 14.03.1991). The distribution of the heavy metals according to their forms is given in Figure 7.1 with their weight percentages.

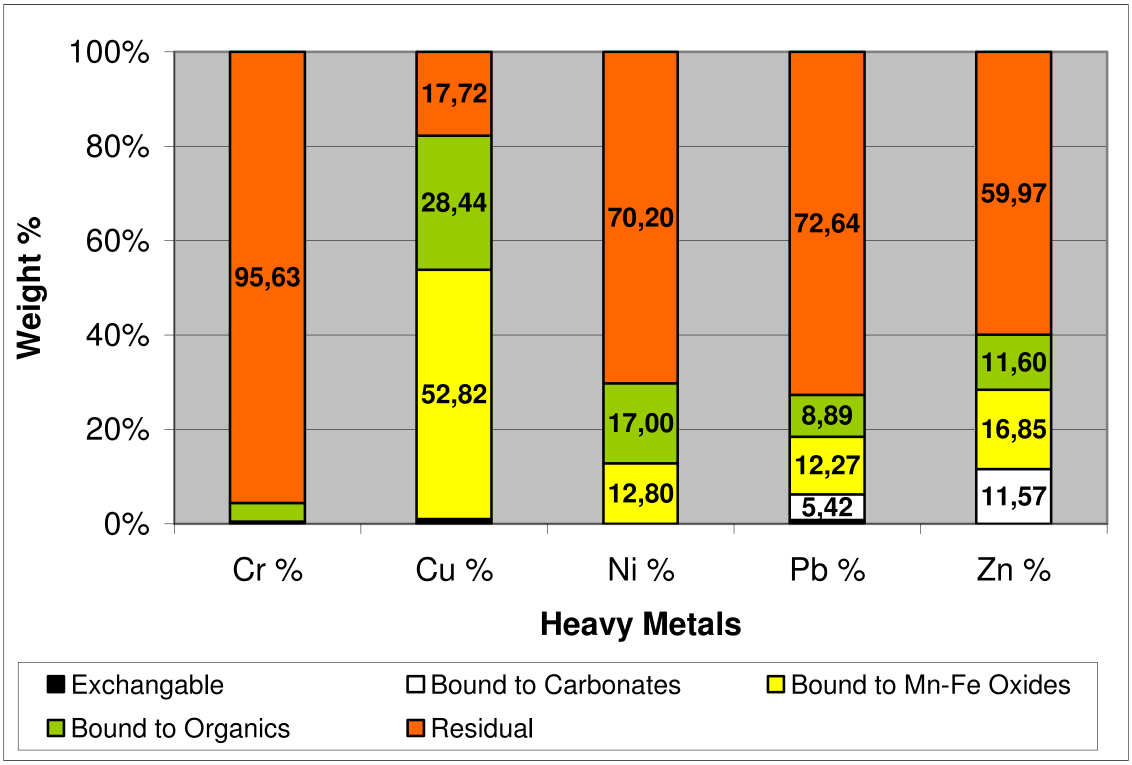

Figure 7.1. The distribution of the forms of the heavy metals in iron and steel slag

As can be seen from the Figure 7.1, 96 % of the Cr is present in residual form, which is not expected to be dissolved. So, the high concentration of Cr in the slag is in a nonhazardous state under normal environmental conditions. But this case is not the same for Cu. 53 % of Cu is bounded to Mn-Fe Oxides, which are readily soluble in small pH decreases. A significant amount of Pb, Ni, and Zn are in fixed form (residual). Therefore, in the case of any relase under aggressive conditions the total amount of those metals reaching environment will not be create any hazard.

The change of compressive strength with increasing amount of sand replacement and time is given in Figures 7.2. Since the cement replacement with slag didn't show any improvement on the compressive strength of the mortar the results are not further discussed.

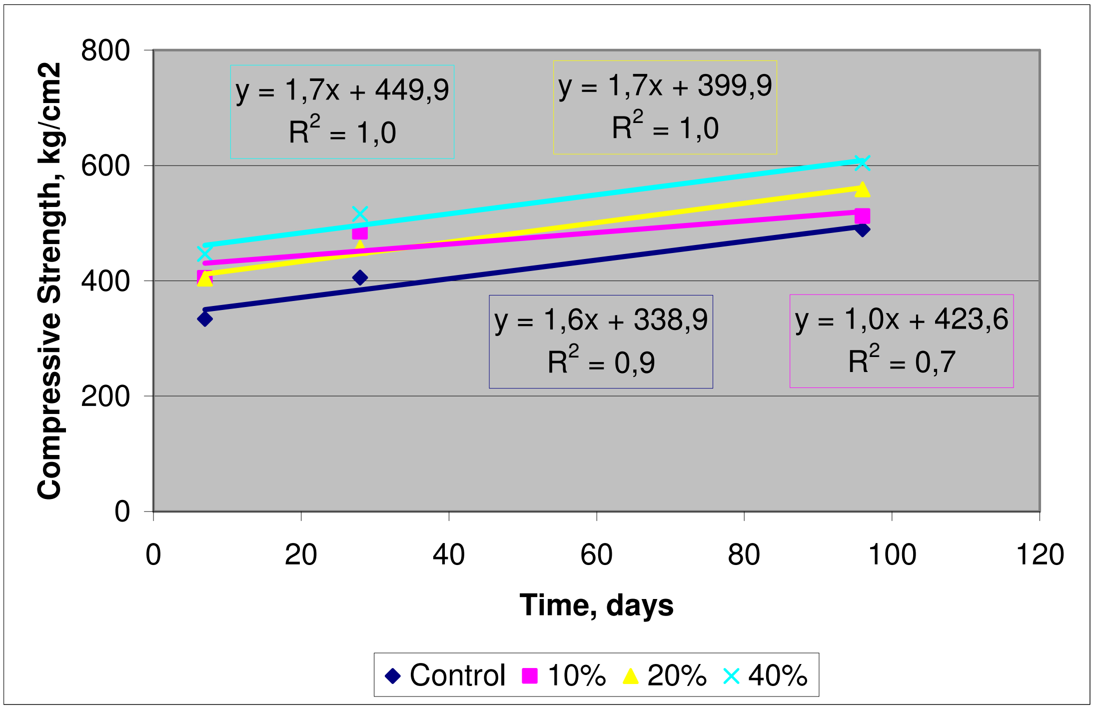

Figure 7.2. The change in the compressive strengths in time- slag replacement with sand

Sand replacement presented a 23.5 % more compressive strength at the end of the 96th day with a replacement ratio of 40% (Figure 7.3).

It can be said that decreses in the amount of cement is not adviced when the use of slag is considered, but replacement sand with slag is recommended to increase the compressive strength of the concrete.

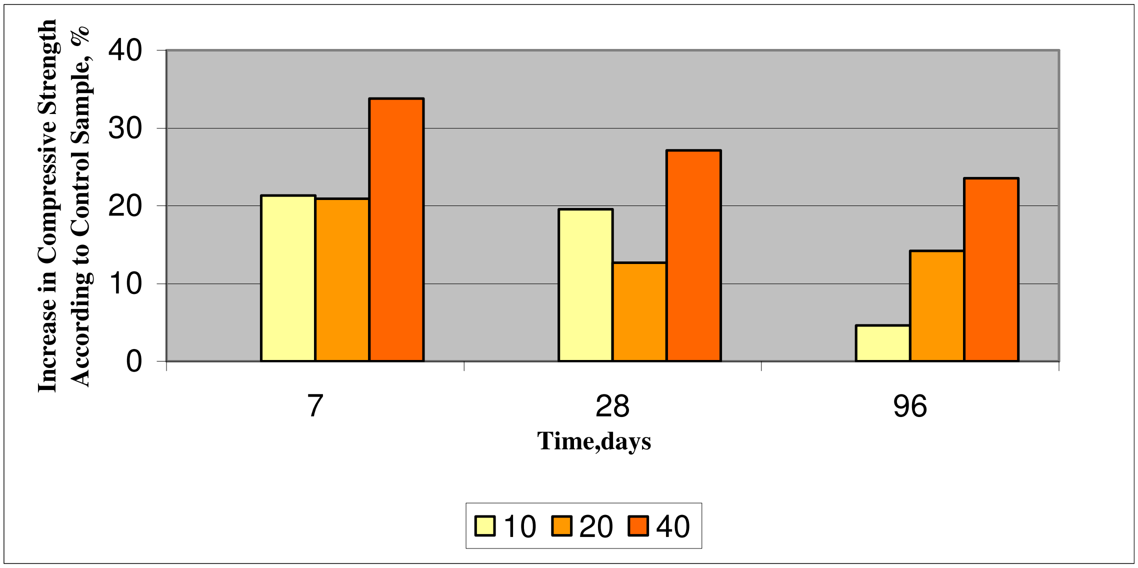

Figure 7.3. The improvement in the compressive strength of mortar in time according to the control sample in the case of slag replacement

7.2.2 Discussion of the Waste Management Studies

According to two different scenarios studied in Chapter 5, ten risk groups are determined. In Table 7.5 the ranking of risks in each scenario are presented.

Table 7.5 The ranking for the risk groups according to two scenarios

SCENARIO I		SCENARIO II	
Risk Group	**Environmental Aspect**	**Risk Group**	**Environmental Aspect**
1	Slag Storage	**1**	Slag Storage
	Carbondioxide amount		Carbondioxide amount
2	Fire	**2**	Fire
3	Flood		Machine oil usage
	R22 tubes		Noise from working machines
	Machine oil usage	**3**	Flood
	Noise from working machines		Repair of machinary
4	Repair of machinary		Exhaust emission
	Exhaust emission		Usage of underground water

	Usage of underground water		Flue gas emissions
	Flue gas emissions	**4**	R22 tubes
5	Radioactive scrap	**5**	Process wastewater
6	Process wastewater		Storage of treatement sludge
	Storage of treatement sludge		Discharge of treated water
	Discharge of treated water	**6**	Radioactive scrap
7	Earthquake	**7**	Wastewater treatment system process desruption
8	Wastewater treatment system process desruption	**8**	Medical waste
9	Medical waste	**9**	Earthquake
10	Vehicle accidents in factory	**10**	Vehicle accidents in factory

Comparison of the scenarios according to the contents of the risk groups are discussed below:

Risk Group 1:

In both of the scenarios the environmental aspects in the first risk group are same and they are namely; slag storage and CO_2 amount which are the most important troubles that the facility has deal with.

Risk Group 2:

In Scenario I; only the fire possibilty is seen in the 2nd risk group, while machine oil usage and the noise generated by the machinary and equipments are also present in the same group in Scenario II. High oil concentration in industrial wastewater because of machine oil consumption for the systems and soil contamination in factory surroundings originated by the leaks and the spills from the scattered oil barrels are the important environmental risks, but not as much as a damage caused by a fire. According to the contents, the findings of Scenario I seems much meaningful for this risk group.

Risk Group 3:

The mutual environmental aspect present in the 3rd risk group in both scnerios is the possibility of a flood occurance. Machine oil usage and noise from working machines, which were present in the second risk group in Scenario II, are present in the third risk group in Scenario I. Another important aspect as consumption of R22 -human health threathening chemical agent- is also placed in the contents of this risk group in Scenario I, which is not present in this risk group in Scenario II. At the other hand, because of air pollution risk R22 usage is forbidden according to Kyoto Protocol in most of the countries in the world. This gap in Scenario II is unfortunately is enlarged by the presence of "Repair of Machinery" article in the contents of this risk group, which has not that much importance as an environmental risk. The presence of underground water usage as an aspect in the list of Scenario II is appreciated for this risk group.

Risk Group 4:

The usage of ground water is present in the fourth risk group in Scenario 1 which is acceptable according to the previous rankings of the environmental aspects. Flue gas emissions, which has high importance because of its contribution to air pollution, has its place also in the fourth risk group in Scenario I. Scenario II includes only R22 tubes in this risk group, which has a higher importance according to the previous aspects ranked in this scenario.

Risk Group 5:

Scenario I includes the probem of radioactive scrap wastes in this rank. Even this aspect has a very low occurrence probability, in the case of occurrence they may create very serious environmental hazards, so the ranking is correct for this kind of waste. Scenario II skips radioactive wastes and its content covers process wastewater, storage of treatment sludge, and discharge of treated water. The environmental risks of those three aspects may never be higher then a radioactive waste problem.

Risk Group 6:

Process wastewater, storage of treatment sludge, and discharge of treated water are ranked in this risk group in Scenario I. Scenario II includes only radioactive scrap. Again an opposite ranking system in Scenario II has seen compared to the Scenario I.

Risk Group 7:

Earthquake is the only environmental risk in Scenario I and it has a greater importance than the wastewater treatment system desruption which has placed in the same risk group in Scenario II. Because if the wastewater treatment system will be desrupted, it will be probably caused by an earthquake.

Risk Group 8:

Medical waste in such a facility may be produced in very small amounts and in plant control of this kind of wastes are much easily solved. Because of that Scenario I has abetter ranking with the aspect of the wastewater treatment system desruption in risk group 8.

Risk Group 9:

Medical waste is seen in Scenario I and the Earthquake is seen in Scenario II in the risk group of nine. It is clear that the importances of the environmental risks for those aspects are not even comparable. Earthquake needs to be placed in a higher rank in Scenario II.

<u>Risk Group 10:</u>

Vehicle accidents in the factory has the same and the last rank in both scenarios, which is correctly placed.

According to the comparisons of the scenarios for each risk group, Scenario I has a beter ranking methodology. The priorities of the environmental aspects are much meaningful for ISO 14000 point of view.

The objectives and targets for the facilty is presented below according to the ranking system described by Scenario I.

7.2.2.1 Environmental Objectives and Targets

Environmental objectives and targets of the facility are determined according to the environmental aspects & impacts and environmental legislations.

The environmental objectives and targets of iron and steel factory are,

- **Objective 1:** To reduce of slag amount.
  - **Target 1.1:** To supply good quality of scrap to reduce slag amount from 10% to 8% in the first year
  - **Target 1.2:** Reuse generated slag in civil engineering applications

- **Objective 2:** To reduce of greenhouse gas (R22 and CO_2) emissions.
  - **Target 2.1:** R22, which is used as cooling gas, can be changed with a distinct gas to prevent or reduce the greenhouse effect originated by the emissions.
  - **Target 2.2:** 3 % decrease in emitting carbon dioxide by using biofuels or natural gas.

- **Objective 3:** To reduce the noise and to prevent the damage on the environment.
  - **Target 3.1:** Controlling the machines and the vehicles periodically.
  - **Target 3.2:** Training the staff and making them use the preventive equipments.

- **Objective 4:** To reduce water usage.
  - **Target 4:** To build industrial wastewater treatment plant and reuse treated water in process may reduce the water usage as 40%

- **Objective 5:** To prevent pollution caused by spilling or leaking of hazardous waste .
  - **Target 5.1:** Arrange a chemical materials storage area.
  - **Target 5.2:** Training the staff about chemical materials, their hazards and the prevention methods.

- **Objective 6:** To store the solid wastes properly.
  - **Target 6:** To build storage and disposal areas for solid wastes.

- **Objective 7:** To control and dispose of medical wastes in order not to damage environment and human health.
  - **Target 7.1:** Collect the medical wastes separately
  - **Target 7.2:** Make temporary medical waste disposal area.

Waste minimization and recycling of wastes should be considered since the amount of waste in the facilty creates big problems. Here, the possible waste management applications investigated according to the ISO 14000 Environmental Management

System and environmental performance increase of the company is aimed. According to the content of the study the management ways of waste generated in the facility can be listed as follows:

Solid Waste Management:

The major solid waste generated in the facility is iron and steel slag. The amount of the generated slag is 130.000 tons/year. This huge amount of slag is cummulated in an area inside of the facility backyard. This amount should be decreased immediately. For this purpose the facillty must be more selective on scrap iron purchase. The amount of slag will be reduced significantly with increasing quality of scrap iron. After this application, the reuse of slag should be considered. The studies about reuse of slag is reported in the previous part of this section.

Another problem is to store the treatment sludges from wastewater treatment plant with the slags in the same area. This is an negative situation for the facility. Treatment sludges should be disposed of according to the related legislations.

Wastewater Management:

The domestic wastewater generated in the facility are treated. But there is not any special treatment system for the industrial wastewater generated in the facility. Clean water is used in the production line for cooling purposes. If an industrial wastewaster treatment plant is built and will be operated, the treated industrial wastewater can be used for cooling purposes. By this way, the amount of the water consumed in the facility will be decreased. The cooling water is supplied from the wells, so reuse of treated water will help to protection of natural sources.

Air Pollution Management:

The dust generated during production is collected in a dust collection system with 1.200.000 m^3/hour capacity. Another benefit of using high quality scrap iron is to reduce the amount of dust generated in the facility.

CO_2 is emitted during production. Because of the green house effect created by CO_2, some studies are being conducted by the researchers. Kyoto Agreement plays an important role on accelerating this studies.

Hazardous Waste Management:

The hazardous wastes generated in the facility are: mineral oils, accumulators, batteries, flouresence lamps, computer parts, and electronical circuits. All of those waste should be disposed of according to the related legislation.

Medical Waste Management:

Any process control is not applicable for the medical wastes generated in the facility. They should be disposed of according to related legislation.

The recyclable waste is not collected separately in the facility. But some studies are started for this purpose.

CHAPTER EIGHT
CONCLUSION

The Environmental Management System requirements that are environmental policy, planning, implementation and operation, checking and corrective action and management review was presented in this study.

At this study we have chosen a facility working as iron and steel factory as a case study area and the requirements of EMS according to ISO 14001 standard are evaluated. Our goal was to establish first implementation guideline that includes implementation steps of Environmental Management System for iron and steel organizations.

This research provided an approach to implement EMS according to the ISO 14001 standard. I wish companies pursue to ISO 140001 Environmental Management Systems and maintain business excellence while considering environmental quality.

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