

**EVALUATION OF HAZARDOUS WASTE MANAGEMENT
SYSTEM IN TURKEY**

**TÜRKİYE'DEKİ TEHLİKELİ ATIK YÖNETİM SİSTEMİNİN
DEĞERLENDİRİLMESİ**

ESRA ATEŞ

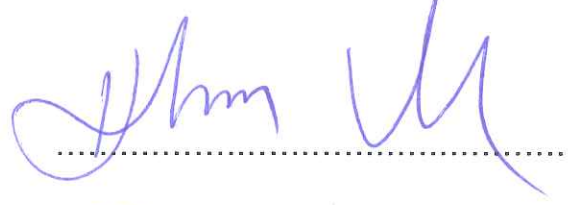
Assoc. Dr. SELİM LATİF SANİN
Supervisor

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This work named “**Evaluation of Hazardous Waste Management System in Turkey**” by **ESRA ATEŞ** has been approved as a thesis for the Degree of **MASTER OF SCIENCE IN ENVIRONMENTAL ENGINEERING** by the below mentioned Examining Committee Members.

Prof. Dr. İbrahim USLU
Head



Assoc. Prof. Selim Latif SANIN
Supervisor



Prof. Dr. Gülen GÜLLÜ
Member



This thesis has been approved as a thesis for the Degree of **MASTER OF SCIENCE IN ENVIRONMENTAL ENGINEERING** by Board of Directors of the Institute for Graduate School of Science and Engineering.

Prof. Dr. Menemşe GÜMÜŞDERELİOĞLU
Director of the Institute of
Graduate School of Science and Engineering

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To my family

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ABSTRACT

EVALUATION OF HAZARDOUS WASTE MANAGEMENT SYSTEM IN TURKEY

Esra ATEŞ

**Master Degree of Science, Department of Environmental
Engineering**

Supervisor: Assoc. Prof. Selim Latif SANİN

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In this thesis, it is determined that most of the hazardous waste was generated during metal manufacturing in Turkey. The amount of hazardous waste of Turkey was predicted by using population, gross domestic product, industrial production, municipal waste production and the number of people who takes tertiary education. As a result, it was determined that although the relationship between population and hazardous waste production is not very strong, there is a relation between GDP and hazardous waste amount according to the data sets of Turkey. Moreover, it was found that the industrial production and municipal waste slightly affect hazardous waste production but there is a relation between the number of tertiary educated people and hazardous waste amount. These selected factors were examined with respect to total data sets of ten European countries and it was found that all factors are effective, except the number of people who takes tertiary education. Hazardous waste removal facilities in Turkey were searched and so, it was determined that there were 201 hazardous waste recycling facilities, 36 hazardous waste incineration and co-incineration facilities and 8 hazardous waste

landfills in 2015. Moreover, the number of these facilities was analyzed in accordance with province and it was determined that most of hazardous waste removal facilities are in big cities where industry developed but there are not any facilities in some small cities although hazardous waste is produced in these. Namely, it was understood that from west to east the number of hazardous waste facilities decrease. In addition to these, it was found that most of the license is about hazardous waste recycling (29 %) in 2015. Furthermore, it was understood that the development indexes of provinces may affect the number of hazardous waste recycling facilities and the total number of hazardous waste removal facilities. Hazardous waste management problems were examined and it was determined that the most important problem in Turkey is unknowing the exact hazardous waste inventory. As a result of this, hazardous waste inventory was tried to calculate in order to evaluate current hazardous waste management system and so, a method were created by using the data of ten European countries about population, gross domestic product, industrial production, municipal waste and the number of tertiary educated people. After all, it was found that 8,345,939 ton should have been produced in addition to known hazardous waste amount from 2009 to 2015. Besides, when removal cost of this amount was calculated it was determined 2,169,944,140 TL to bury, minimum 4,172,969,500 TL and maximum 25,037,817,000 TL to incinerate, and lastly, 1,226,853,033 Dollars to recycle should be spent. It was found that if this amount which was calculated as 8,345,939 ton is buried, environmental cost of this amount will be 219,915,493 Euros but if this amount is incinerated, environmental cost of this amount will be 383,495,897 Euros. Apart from these, investment cost for landfill and incineration plants were examined and it was determined that investment cost for landfill construction is approximately 7.5 million Euros and investment cost for incineration construction is between 316-373 million TL. Consequently, it is determined that existing hazardous waste management system in Turkey has some deficiencies and so, it needs to be further developed from this thesis.

Keywords: Hazardous waste, inventory, management systems, legislations, management problems, cost, European Union

ÖZET

TÜRKİYE'DEKİ TEHLİKELİ ATIK YÖNETİM SİSTEMİNİN DEĞERLENDİRİLMESİ

Esra ATEŞ

Yüksek Lisans, Çevre Mühendisliği Bölümü

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Bu tez çalışmasında, en çok atığın metal imalatında üretildiği belirlendi. Türkiye'de üretilen tehlikeli atık miktarları nüfus, gayri safi yurtiçi hasıla, sanayi üretimi, belediye atıkları üretimi ve yükseköğrenim gören kişi sayısı faktörleri kullanılarak tahmin edildi. Sonuç olarak, nüfus ile tehlikeli atık miktarı arasındaki çok kuvvetli bir bağıntı olmasa da, gayri safi yurtiçi hasıla ile tehlikeli atık miktarı arasında bir bağıntının var olduğu Türkiye verilerine göre belirlendi. Buna ek olarak, sanayi üretimi ve belediye atık üretimi faktörlerinin tehlikeli atık miktarını çok az bir oranda etkilediği fakat yükseköğrenim gören kişi sayısı ile tehlikeli atık miktarı arasında bağıntının olduğu bulundu. Belirlenen bu faktörler, 10 Avrupa ülkesinin veri setlerinin toplamına göre incelendi ve yükseköğrenim gören kişi sayısı hariç bütün faktörlerin etkili olduğu belirlendi. Türkiye'deki tehlikeli atık arıtım tesisleri araştırıldı ve böylece, 2015 yılında, Türkiye'de 201 tane tehlikeli atık geri dönüşüm tesisinin, 36 tane yakma ve birlikte yakma tesisinin ve 8 tane de atık gömme tesisinin olduğu belirlendi. Buna ek olarak, illere göre tehlikeli atık arıtım tesislerinin sayısı incelendi ve tehlikeli atık arıtım tesislerinin çoğunluğunun endüstrinin geliştiği

büyük şehirlerde olduğu fakat bazı küçük şehirlerde, tehlikeli atık üretilmesine rağmen tehlikeli atık arıtım tesisinin olmadığı bulundu. Diğer bir deyişle, batıdan doğuya gidildikçe tehlikeli atık arıtım tesisi sayısının azaldığı anlaşıldı. Ayrıca, tehlikeli atık arıtım tesisleri, izin ve lisans konularına göre incelendi. 2015 yılında, en çok izinin tehlikeli atığın geri dönüşümü konusunda (% 29) alındığı bulundu. Buna ek olarak, tehlikeli atık arıtım tesislerinin sayısı illerin gelişmişlik göstergelerine göre incelendi. Sonuç olarak, illerin gelişmişlik göstergelerinin tehlikeli atık geri dönüşüm tesis sayısını ve toplam tehlikeli atık arıtım tesis sayısını etkileyebileceği anlaşıldı. Tehlikeli atık yönetim problemleri incelendi ve Türkiye'deki en önemli problemin tehlikeli atık miktarının tam olarak bilinmemesi olduğu belirlendi. Bunun sonucu olarak da, mevcut tehlikeli atık sistemini değerlendirmek için tehlikeli atık envanteri hesaplanmaya çalışıldı ve böylece, 10 Avrupa ülkesinin nüfus, gayri safi yurtiçi hasıla, endüstriyel üretim, belediye atık üretimi ve yüksek öğrenim gören kişi sayısı faktörleri kullanılarak bir metot oluşturuldu. Sonuç olarak, 2009 yılından 2015 yılına kadar olan sürede, bilinen tehlikeli atık miktarına ek olarak 8.345.939 ton tehlikeli atığın üretilmiş olması gerektiği belirlendi. Ayrıca, bu atığın arıtım maliyeti hesaplandığında, sırasıyla, 2.169.944.140 TL'nin gömmek için, minimum 4.172.969.500 TL ve maksimum 25.037.817.000 TL' nin yakmak için ve son olarak da 1.226.853.033 Doların geri dönüşüm için harcanması gerektiği belirlendi. Şayet 8.345.939 ton olarak belirlenen bu miktar gömülürse, bu atığın çevre maliyetinin 219.915.493 Euro olacağı fakat yakılırsa bu atığın çevre maliyetinin 383.495.897 Euro olacağı bulundu. Bunların dışında, gömme ve yakma tesislerinin yatırım maliyeti incelendi ve gömme tesisi için yatırım maliyetinin yaklaşık olarak 7,5 milyon Euro ve yakma tesisi için yatırım maliyetinin 316-373 milyon TL arasında olduğu belirlendi. Sonuç olarak, bu tez çalışmasından, Türkiye'deki mevcut tehlikeli atık yönetim sisteminin bazı eksikleri olduğu ve bu yüzden, daha çok geliştirilmesi gerektiği belirlendi.

Anahtar Kelimeler: Tehlikeli atık, envanter, yönetim sistemleri, mevzuatlar, yönetim problemleri, maliyet, Avrupa Birliği

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ABBREVIATIONS

EPA	Environmental Protection Agency
MoEF	Ministry of Environment and Forestry
EIS	Environmental Information System
TABS	Hazardous Waste Declaration System
HWDS	Hazardous Waste Declaration System
NACE	Nomenclature of Economic Activities
MHWT	Mobile Hazardous Waste Transport
UATF	Printed National Waste Transport Forms
EU	European Union
TURKSTAT	Turkish Statistical Institute
SIS	State Institute of Statistics
EUROSTAT	European Statistics
GDP	Gross Domestic Product
eDAMIS	electronic Dataflow Administration and Management Information System
ISO	International Organization for Standardization
TİM	Turkish Exporters Assembly
BRSA	Banking Regulation and Supervision Agency
BTK	Information and Communication Technologies Authority
TBB	The Banks Association of Turkey

1. INTRODUCTION

The development of fields such as technology and industry in the world has led to environmental problems and these problems effects not only environment but also all living creatures. When these problems are brought to light, there is no doubt that one of the most important of these problems is the waste problem, especially hazardous waste problem because despite the development, the amount of hazardous waste and the effect of it is not exactly known in the world. When the hazardous waste amount in the world is searched, only hazardous waste in European countries is approximately known. However, unfortunately, it is found that the latest hazardous waste amount in European countries is available for 2012 and this value is approximately 100 million tons [1]. Therefore, the importance of this hazardous waste problem must be clearly understood and that's why it is necessary to know exactly what the waste and the hazardous waste is.

Waste is any remaining substances after the use of any resource and when it effects the environment and all living creatures negatively, it becomes hazardous waste. For example, wastes like waste oils, paint and varnish residuals, batteries and accumulators, organic solvents, pesticides, fluorescent lamps, asbestos containing materials, medical waste leachate, etc. are hazardous waste, of which list is given in Table C-1 in Appendix-C. The definition and explanation of waste and hazardous waste will be detailed in Section 1.1 and Section 1.2.

1.1. Definition of Waste

As defined in Waste Management Regulation in Turkey;

“It is any substance or material that is thrown into the environment by the genuine or legal person holding it, or is obliged to be removed.” [2]

As defined under the Environment Protection Act 1993;

“Waste means any discarded, rejected, abandoned, unwanted or surplus matter, whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter.” [3]

In short, waste means any matter which is resulted from any activity and, disposed or released in the environment.

Waste can be categorized in three groups in terms of effects, structure and sources, given in Table 1-1 [4].

Table 1-1: Waste Categories [4]

Waste in terms of effects	Waste in terms of structure	Waste in terms of sources
<ul style="list-style-type: none"> • Hazardous waste • Non-hazardous waste 	<ul style="list-style-type: none"> • Solid waste • Liquid waste • Gas waste 	<ul style="list-style-type: none"> • Household waste • Industrial waste • Commercial and institutional waste • Agricultural waste • Special waste

1.2. Definition of Hazardous Waste

According to Waste Management Regulation in Turkey;

“Hazardous waste is wastes containing one or more of the hazardous waste characteristics, which are shown in Table 1-2, and wastes in hazardous waste list in Table C-1 in Appendix-C (which is similar to hazardous waste list in Council Directive 91/689/EC on hazardous waste)”.

According to EPA (Environmental Protection Agency);

“A hazardous waste is a waste with a chemical composition or other properties that make it capable of causing illness, death, or some other harm to humans and other life forms when mismanaged or released into the environment.” [5]

In other words, a hazardous waste is a waste which affects humans and other living organisms negatively, directly and certainly.

When the definition of hazardous waste is examined for European Union and Turkey, it is understood that the definition of hazardous waste is almost identical to that of EPA because all of them use similar hazardous waste list in Council Directive 91/689/EC on hazardous waste. However, Turkey added some information when Council Directive 91/689/EC on hazardous waste adapted to Waste Management Regulation of Turkey and these are additions to the hazardous waste characteristics, which are H13 and H15 as shown in Table 1-2.

Hazardous wastes characteristics which are given in Council Directive 91/689/EC on hazardous waste (which is also used in Turkey), given in Table 1-2 [6].

Table 1-2: Hazardous Waste Characteristics [6]

H1: Explosive	Substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.
H2: Oxidizing	Substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.
H3-A : Highly flammable	<ul style="list-style-type: none">✓ Liquid substances and preparations having a flash point below 21 °C (including extremely flammable liquids),✓ Substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy,✓ Solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition,✓ Gaseous substances and preparations which are flammable in air at normal pressure,✓ Substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities.
H3-B: Flammable	Liquid substances and preparations having a flash point equal to or greater than 21 °C and less than or equal to 55 °C.
H4: Irritant	Non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation.
H5: Harmful	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks.
H6: Toxic	Substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death.
H7: Carcinogenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce cancer or increase its incidence.
H8: Corrosive	Substances and preparations which may destroy living tissue on contacts.
H9: Infectious	Substances containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms.
H10: Teratogenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce non-hereditary congenital malformations or increase their incidence.

H11: Mutagenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce hereditary genetic defects or increase their incidence.
H12	Substances which release toxic or very toxic gases in contact with water, air or an acid.
H13: Sensitizer	Substances and preparations which may cause a hypersensitivity reaction if they are inhaled or they penetrate the skin and may cause characteristic adverse effects in case of exposure to them for a long time.
H14: Ecotoxic	Substances which present or may present immediate or delayed risks for one or more sectors of the environment.
H15	Substances capable by any means after disposal of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above.

In order to manage and control hazardous waste, hazardous waste legislation and hazardous waste management system has made and developed.

1.3. History of Hazardous Waste Management

After humans began moving away from their nomadic habits to establish primitive societies around 10,000 BC, waste started to become an issue to deal with [7] and then, in progress of time, waste problem began to grow more with the increase in the population. In later periods, with the development of industry and technology, the amount of waste, especially hazardous waste, increased and so, people started to look for solutions to manage these waste.

Environmental Protection Agency (EPA) firstly made " Priority Pollutant" list by thinking about specific chemicals in water in 1976 in the area of hazardous waste. Also in this year, EPA made Resource Conservation and Recovery Act in order to manage hazardous waste [8]. However, the emergency of hazardous waste management was understood after Love Canal, which is an aborted canal project branching off of the Niagara River about four miles south of Niagara Falls because this area partially was used as a chemical waste dump from 1942 to 1953 by the Hooker Chemical Company. Therefore, at the end of this period, the contents of the canal consisted of around 21,000 tons of toxic chemicals. As a result of this, in the late 1970s, this area caused emergence of a lot of diseases like epilepsy, asthma, migraines, and nephrosis and also, it caused abnormally high rates of birth defects and miscarriages in the Love Canal neighborhood [9].

In the 1970s and 1980s, public awareness of disposal of hazardous waste unfolded and as a result of this, the disposal of hazardous waste became more difficult and the disposal cost of hazardous waste increased. Because of this, some operators sought cheap disposal options for hazardous waste and they started to ship hazardous waste to Eastern Europe and the developing countries, where regulations and enforcement mechanisms were lacking. Therefore, The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal was adopted in 1989 and entered into force in 1992 [10]. As in many European countries, in Turkey, the proper hazardous waste management was started to develop after the ratification of Basel Convention in 1994 and other regulations about hazardous waste followed this convention in Turkey, which will be mentioned in Section 1.3.

1.4. Hazardous Waste Management in Turkey

1.4.1. Hazardous Waste Legislation in Turkey

Environmental Law of Turkey was enacted. This law included descriptions about hazardous waste but related directives were not enforced. After *Environmental Law*, in 1991 *Solid Waste Control Regulation*, which was abolished, and in 1993, *Medical Waste Control Regulation* (revised in 2005) was made but there is no information about monitoring of hazardous waste in these regulations. Therefore, it can be said that before 1994, there was no comprehensive monitoring of hazardous waste. After the ratification of *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* in 1994, the development of hazardous waste management system in Turkey has started. Right after the ratification of this convention, in 1995 *Hazardous Waste Control Regulation* was made (revised in 2005 and in 2009-2010). According to Table 1-3, developments in the hazardous waste management were slow, until early 2000s. However, in 2000s, with the initiation of accession period to European Union [11], almost all of directives have been adopted and put in action in the field of hazardous waste management. Regulations which are compatible with EU were also activated. In 2004, *Regulation on Control of Waste Oil* (revised in 2008), *Excavation, Construction and Demolition Waste Control Regulation*, *Regulation on the Control of Packaging Waste* (revised in 2007 and in 2011) and *Regulation on Control of Waste Batteries and Accumulators* (revised in 2005) were made.

Following that, in 2005, *Regulation on Control of Waste Vegetable Oils* was made. In 2006, *Law on Amendment to Environmental Law* and *Regulations on Control of End-of-Life Tires* were made. In 2007, *Regulation on the Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls* was made. After that, in 2008, *Regulation on the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment* and *Regulation on the General Principles of Waste Management* were made. In addition to these, in this year, *Regulation on the Inventory and Control of Chemicals* was made. Right after this year, in 2009, *Regulations on Control of End of Life Vehicle* was made. Besides, in 2010, not only *Regulation on Landfill of Waste* was made but also *Regulation on Incineration of Waste* was made. Apart from these, *Technical Procedure Communique on Storage, Decontamination, Dismantling and Processing of End of Life Vehicles* was made. Moreover, in 2012, *Regulation on Control of Waste Electrical and Electronic Equipment* was made and after this year, in 2013, some changes in *Hazardous Waste Regulation* were made and it was repealed in 2015 with going in effect of *Waste Management Regulation*. Besides, *Regulation on the General Principles of Waste Management* was repealed. In 2015, *Mining Waste Directive* was made. Lastly, *Amending Regulation on Mining Waste Directive* was made in 2016. The hazardous waste regulation diagram in Turkey was given in Figure 1-1.

Table 1-3: Historical development in Legislative regulations in the field of hazardous waste [12], [13]

Date	Legislative Regulation
09.08.1983	Environmental Law
14.03.1991	Solid Waste Control Regulation
20.05.1993	Medical Waste Control Regulation
1994	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
1995	Hazardous Waste Control Regulation
21.01.2004	Regulation on Control of Waste Oil
18.03.2004	Excavation, Construction and Demolition Waste Control Regulation
30.07.2004	Regulation on the Control of Packaging Waste
31.08.2004	Regulation on Control of Waste Batteries and Accumulators
03.03.2005 (Revision)	Regulation on Control of Waste Batteries and Accumulators
14.03.2005 (Revision)	Hazardous Waste Control Regulation
19.04.2005	Regulation on Control of Waste Vegetable Oils

Date	Legislative Regulation
22.07.2005 (Revision)	Medical Waste Control Regulation
13.05.2006	Law on Amendment to Environmental Law
25.11.2006	Regulations on Control of End-of-Life Tires
24.06.2007 (Revision)	Regulation on the Control of Packaging Waste
27.12.2007	Regulation on the Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls
30.05.2008	Regulation on the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment
05.07.2008	Regulation on the General Principles of Waste Management
30.07.2008 (Revision)	Regulation on Control of Waste Oil
26.12.2008	Regulation on the Inventory and Control of Chemicals
30.12.2009	Regulations on Control of End of Life Vehicle
2009-2010 (revision)	Hazardous Waste Control Regulation
26.03.2010	Regulation on Landfill of Waste
06.10.2010	Regulation on Incineration of Waste
26.04.2011	Communique on Waste Intermediate Storage Facilities
06.07.2011	Technical Procedure Communique on Storage, Decontamination, Dismantling and Processing of End of Life Vehicles
24.08.2011 (Revision)	Regulation on the Control of Packaging Waste
22.05.2012	Regulation on Control of Waste Electrical and Electronic Equipment
05.11.2013	Amending Regulation on Hazardous Waste Control Regulation
20.03.2015	Communique on Transportation of Waste in Highway
02.04.2015	Waste Management Regulation
15.07.2015	Mining Waste Directive
16.07.2016	Amending Regulation on Mining Waste Directive

When the regulations are made, EU Directives, which are shown in Table 1-4, are taken into account. Regulations which are not included in Table 1-4 were made to comply with EU Directives completely.

Turkish Republic Constitution	(1982)
Environmental Law of Turkey	(1983)
Solid Waste Control Regulation (Abolished)	(1991)
Medical Waste Control Regulation (Revision in 2005)	(1993)
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	(1994)
Hazardous Waste Control Regulation (Abolished)	(1995)
Regulation on Control of Waste Oil (Revision in 2008)	(2004)
Excavation, Construction and Demolition Waste Control Regulation	
Regulation on the Control of Packaging Waste (Revision in 2007 and 2011)	
Regulation on Control of Waste Batteries and Accumulators (Revision in 2005)	
Regulation on Control of Waste Vegetable Oils	(2005)
Regulation on Control of End –of-Life Tires	(2006)
Regulation on the Control of Polychlorinated Biphenyls and Polychlorinated Terphenyls	(2007)
Regulation on the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment	(2008)
Regulation on the General Principles of Waste Management (Abolished)	
Regulation on the Inventory and Control of Chemicals	
Regulation on Control of End of Life Vehicle	(2009)
Regulation on Landfill of Waste	(2010)
Regulation on Incineration of Waste	
Regulation on Control of Waste Electrical and Electronic Equipment	(2012)
Waste Management Regulation	(2015)
Mining Waste Directive	

Figure 1-1: Hazardous waste regulation diagram in Turkey

Table 1-4: EU Counterpart of Turkish Legislation [14]

Turkish Legislation	EU Counterpart
Hazardous Waste Control Regulation	Directive 91/689/EEC on hazardous waste
Regulation on Control of Waste Batteries and Accumulators	Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators
Regulation on Control of Waste Vegetable Oils	Under Directive 2008/98/EC on waste
Medical Waste Control Regulation	Under Directive 2008/98/EC on waste
Regulations on Control of End-of-Life Tires	Under Directive 2008/98/EC on waste
Regulation on Control of Polychlorinated Biphenyl and Polychlorinated Terphenyls	Directive 96/59/EC on the disposal of polychlorinated biphenyls and polychlorinated terphenyls
Regulation on the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment	Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment
Regulation General Principle of Waste Management	Directive 2008/98/EC on waste
Regulation on Control of Waste Oils	Directive 75/439/EEC on the disposal of waste oils
Regulation Control of End-of-Life Vehicles	Directive 2000/53/EC on End-of-Life Vehicles
Regulation on Landfill of Waste	Directive 1999/31/EC on the landfill of waste
Regulation on Incineration of Waste	Directive 2000/76/EC on the incineration of waste
Regulation on the Control of Packaging and Packaging Waste	Directive 94/62/EC on packaging and packaging waste
Regulation on Control of Waste Electrical and Electronic Equipment	Directive 2002/96/EC on waste electrical and electronic equipment

1.4.2. Hazardous Waste Management System in Turkey

In 1995, in order to determine the amount of hazardous waste, Hazardous Waste Declaration Form was used [15]. In these forms, companies which generate hazardous waste were asked to provide information about their hazardous waste quality and quantity to Ministry of Environment and Forestry (MoEF).

In 2004, the Ministry initiated an information system for Environmental Information System (EIS) in order to serve as an important for environmental management in Turkey [11]. In 2006, Hazardous Waste Declaration System (TABS) has been used [16]. In this system, firms give information about their hazardous waste generation to Ministry by using web side of TABS.

In addition to these, there is Mobile Hazardous Waste Transport system (MHWT) (in Turkish MoTAT) for obtaining information about transportation of waste. Apart from these, Waste Exchange System is used in order to provide re-entering of industrial waste in the production.

1.4.2.1. Hazardous Waste Declaration System

According to Article 9-g of Hazardous Waste Control Regulation, hazardous waste producers are responsible for filling and ratifying Hazardous Waste Declaration Form by using web site which the Ministry prepares until March of the following year. Producers must fill this form by adding the data of the previous year. Also, they must print out it and keep it for five years. Therefore, producers must use this declaration system.

The aim of this system is to record firms which generate hazardous waste, obtain data about hazardous waste and evaluate this data, and also to create hazardous waste inventory.

Producers access to the TABS system page by using the internet address: <http://online.cevre.gov.tr>. After that, producers enter the system by using username and password which is given by Provincial Directorate of Environment and Urban Planning. System consists of 4 parts. First part is company information like company's name, address, telephone number, etc. Second part is sector information. In other words, in this part, producers enter the system business sectors (Nomenclature of Economic Activities (NACE) codes) which their companies operate. Third part is waste information like quantity, unit, etc. Last part is approval procedure. Therefore, producers will have declared their waste [17].

1.4.2.2. Mobile Hazardous Waste Transport System

Mobile Hazardous Waste Transport system is a system in which information about all transport operations are recorded in the source and waste transport companies and vehicles are licensed. Besides, in this system, loaded waste vehicles are monitored en route and so waste transport operations are controlled effectively. Users of this system are;

- ✓ Ministry of Environment and Urbanization,
- ✓ Provincial Directorate of Environment and Urbanization,
- ✓ Waste producers/ authorized institutions,

- ✓ Licensed recycling / disposal facilities,
- ✓ Licensed waste transportation companies,
- ✓ Waste Tracking Service Providers.

Users of this system enter the system by using user codes and passwords which is given for online applications by the Ministry.

First of all, in this system, Waste Transport Company License and Waste Transportation License are given to those who want to use this system. Then, demand, sales and inventory operations of Printed National Waste Transport Forms (UATF) are done. After that, UATFs are filled and approved online. The transportation of waste which includes loading of waste and emptying of waste starts and loaded waste vehicles are monitored by mobile devices en route. Finally, the collected data are monitored, evaluated and reported [18].

1.4.2.3. Waste Exchange System

Waste Exchange System is a system which is established through the chambers of industry and works with the mechanism of supply and demand. In this system, waste is submitted for prospective buyer/seller companies' information. Therefore, waste which is arisen from raw materials operated by enterprises is regained and so, they are utilized by inserting them in the production process for the second time.

The primary purpose of this system is to prevent environmental pollution. The secondary purpose of this system is to transfer adequate resources to future and to ensure the transfer of raw materials of industrial enterprises in production process without waste. Depending on these aims, the overall objectives of Waste Exchange System are as follows;

- ✓ Reducing costs for waste disposal of industrial companies,
- ✓ The marketing of waste materials which provides raw materials to industrial organizations,
- ✓ Especially, planning of waste management of small businesses,
- ✓ Keeping costs of raw materials and waste management to a minimum and, enabling the waste swap,
- ✓ Minimization of the establishment of waste removal facilities which are funded by central and local administration of countries [19].

1.5. Problem Statement

Waste management is an important issue not only for EU countries but also for Turkey because it is a complicated and difficult task and, implementation of EU Regulation for waste management needs serious studies. Especially implementation of EU regulations for management of hazardous waste needs intense study since it requires rearrangement of current system. Therefore, in order to comply with EU Directive, a lot of regulations were made and this situation shows that adaptation has progressed much in Turkey. Although there are developments in hazardous waste management, the determination of hazardous waste inventory is still a serious problem and now, in Turkey, the exact amount of hazardous waste is not known. Therefore, the possible effects of hazardous waste on environment and all living creatures are not known.

1.6. Literature Review

As in Turkey, waste is a major problem in many countries around the world. Especially, the determination of waste inventory is a crucial problem. Therefore, in order to determine waste inventory, factors which affects waste generation have been tried to determine and methods have been tried to develop. In this part, studies done in this field will be explained.

Yılmaz (2006) made a thesis about hazardous waste inventory in Turkey. In this study, waste factors were determined for each hazardous waste classes which are shown in Appendix-C and according to these factors, hazardous waste inventory was calculated [15].

Soysal et al. (2007) made a research about health-care waste in 18 districts in İzmir. In this research, it was found that population of these districts affects the amount of health-care waste [20].

In 2007, according to the research made by Sustainable Development and Regional Planning Division Planning Institute of Jamaica, population and GDP affects solid and hazardous waste generation in Jamaica [21].

Karahan et al. (2011) made a research about waste factors in Turkey. In this research, waste factors were determined for different industrial facilities in terms of tons of hazardous waste generated per 1 ton of production of related industry. As

a result of this study, it was found that the waste factors for metal finishing industry are quite reliable [22].

Gu et al. (2011) made a research in a Chinese city, which is Suzou, about factors affecting household hazardous waste generation. In this research, it was found that there is strong correlation between household hazardous waste generation and, household structure and consumer preferences [23].

Kim et al. (2012) made a study in order to estimate the amount of waste electrical and electronic equipment generated in South Korea and in this research, they used population balance model [24].

Saidan and Tarawneh (2012) made estimation about electronic waste generation in Jordan and they determined that sales data and the average life span of electronic items as waste factors [25].

According to research which made by Beigl et al., there is significant impact of gross domestic product while forecasting municipal solid waste production [26].

In this thesis, like these studies which were mentioned above, we examined effects of GDP and population on hazardous waste generation. Unlike these studies, in this study, the effect of industrial production, municipal waste and tertiary education on hazardous waste generation were examined.

1.7. Objective and Scope of the Study

The aim of this study is to evaluate current hazardous waste management in Turkey and determine the current management problems, and so, try to provide solutions for these problems. When these management problems were determined, hazardous waste inventory problem was investigated and so, in order to do that, some factors, which are population, the number of firms which use hazardous waste declaration form, gross domestic product, industrial production, municipal waste production and the number of people who takes tertiary education, were examined. By making this, these factors (excluding the number of companies because it is only valid for Turkey) and their effects on hazardous waste were analyzed not only in Turkey but also in some European countries, which are Norway, Germany, Belgium, France, Spain, Italy, Greece, Poland, Hungary and Bulgaria. Also, in this thesis, hazardous waste removal facilities were investigated. Besides, in order to understand whether or not there are deficiencies

in current management system in terms of hazardous waste inventory, the hazardous waste inventory was tried to determine by creating new methods. Consequently, the cost of these management problems was tried to determine if there is an effect in terms of monetary side.

2. MATERIALS AND METHODS

In this chapter, data about hazardous waste was examined and so that the data sets which we will use in this thesis were determined.

2.1. Hazardous Waste Data Collection

In order to make comment about hazardous waste situation in Turkey, it is not enough to know the current state of hazardous waste. It is also necessary to know the state of the hazardous waste from past to present. Besides, it is important to know which factors influence the hazardous waste. Therefore, in order to do that, related data about hazardous waste was collected.

Firstly, the amount of hazardous waste from past to present was tried to collect. For this reason, hazardous waste bulletins which prepared by Ministry of Environment and Urbanization were examined and data of hazardous waste amount from 2009 to 2015 were obtained. Unfortunately, data of hazardous waste amount for 2012 could not be found because in this year, data could not be arranged efficiently due to separation of departments in the Ministry according to personal interview in 2015 with Arzu Nuray, Departmental Manager in Data Evaluation Branch Office in Ministry. Also, for 2016, the Ministry has not yet issued a bulletin about hazardous waste amount. In addition to this, hazardous waste amount data before 2009, which includes data from 1994 to 2008, were obtained from the theses found in the system of Council of Higher Education in Turkey. Besides, in order to understand where these hazardous wastes mostly come from, data about business sectors with respect to NACE codes were taken from bulletin of the Ministry for 2013, 2014 and 2015.

Secondly, some factors which were thought to be calculated with low margin error were determined and the data of these factors were collected. One of them is the number of companies using Waste Declaration Form and Hazardous Waste Declaration System. The data about the number of companies using Waste Declaration Form, from 1995 to 1999, were obtained from the theses found in the system of Council of Higher Education in Turkey and also, the data about the number of companies using Hazardous Waste Declaration System between 2006 and 2015 were obtained from bulletin of the Ministry. Besides, the hazardous waste production data between 2010 and 2014 was obtained from TURKSTAT in

order to compare with hazardous waste production in TABS. Another one of these factors is population and the data about population between years of 2000 and 2015 were taken from the studies of Turkish Statistical Institute and an investigation on population and number of voters in Turkey. In addition to these factors, Gross Domestic Product (GDP) was used as a factor and the data about GDP, from 2006 to 2015, were obtained from the studies of Turkish Statistical Institute. Besides, the other factors are industrial production (the production value of industrial products), municipal waste production and the number of tertiary educated people. The data for industrial production and municipal waste production were taken from the studies of Turkish Statistical Institute. However, for industrial production, data from 2005 to 2015 could be obtained and for municipal waste production, data from 1994 to 2014 could be obtained. Moreover, the data for tertiary educated people were taken from Turkish Republic Measuring, Selection and Placement Center and the studies of Turkish Statistical Institute and the data from 2000 to 2014 could be found.

Thirdly, the data about what the number of hazardous waste treatment facilities is and in which provinces these facilities are located were obtained from the webpage of Ministry of Environment and Urbanization for 2015 to evaluate the treatment level of hazardous waste. Besides, in order to understand whether the development indexes of provinces affects the number of hazardous waste treatment facilities, development indexes, and data were taken from the investigation which was made by Türkiye İş Bankası in 2013.

Lastly, in order to compare our data with European countries (which are Norway, Germany, Belgium, France, Spain, Italy, Greece, Poland, Hungary and Bulgaria), all data about hazardous waste amount and factors mentioned above were taken from the studies from the webpage of European Statistics, in which according to our personal communication, data are obtained from electronic Dataflow Administration and Management Information System (eDAMIS which is a modern communications management system allowing easier and more accurate transfer of data between various national, EU institutions and Eurostat [27]), and this data were obtained from the data sets of between years of 2004 and 2012 (which are shown in Table 2-1). Apart from this, these data were used to develop a method for the calculation of hazardous waste inventory.

Table 2-1: Data sets of ten European Countries [1]

Hazardous waste production (ton/year)(10⁶)										
Year	Norway	Germany	Belgium	France	Spain	Italy	Greece	Poland	Hungary	Bulgaria
2004	0.67	20.00	5.20	8.76	3.12	6.13	0.34	1.61	1.36	11.90
2006	1.22	21.71	4.04	8.89	4.03	7.46	0.27	2.38	1.30	13.55
2008	1.45	22.32	5.92	10.89	3.65	6.88	0.25	1.47	0.67	13.04
2010	1.76	19.93	4.48	11.54	2.99	8.54	0.29	1.49	0.54	13.55
2012	1.36	21.98	4.26	11.30	3.11	9.47	0.30	1.74	0.70	11.90
Population (person/year)(10⁶)										
Year	Norway	Germany	Belgium	France	Spain	Italy	Greece	Poland	Hungary	Bulgaria
2004	4.58	82.53	10.40	62.29	42.55	57.50	10.94	38.19	10.12	7.75
2006	4.64	82.44	10.51	63.23	44.01	58.06	11.00	38.16	10.08	7.63
2008	4.74	82.22	10.67	64.01	45.67	58.65	11.06	38.12	10.05	7.52
2010	4.86	81.80	10.84	64.66	46.49	59.19	11.12	38.02	10.01	7.42
2012	4.99	81.84	11.09	65.28	46.82	59.39	11.09	38.06	9.93	7.33
GDP (US \$/year)(10⁹)										
Year	Norway	Germany	Belgium	France	Spain	Italy	Greece	Poland	Hungary	Bulgaria
2004	197.66	2,533.30	332.43	1,808.23	1,124.86	1,654.96	278.17	498.37	166.54	70.91
2006	253.77	2,859.80	368.65	2,040.23	1,358.18	1,856.21	311.13	577.84	187.95	87.29
2008	295.75	3,160.35	403.71	2,249.33	1,540.39	2,063.86	344.68	687.84	209.05	112.28
2010	285.72	3,242.60	425.55	2,320.69	1,504.90	2,056.27	322.25	794.03	216.08	111.95
2012	326.08	3,568.40	465.18	2,446.17	1,509.21	2,134.10	288.03	898.25	225.47	117.95
Industrial production (US \$/year)(10⁹)										
Year	Norway	Germany	Belgium	France	Spain	Italy	Greece	Poland	Hungary	Bulgaria
2004	163.00	912.00	85.80	403.00	412.00	540.00	26.50	104.00	29.70	12.10
2006	159.00	998.00	94.30	408.00	432.00	557.00	26.30	122.00	35.40	13.70
2008	157.00	1,060.00	104.00	399.00	407.00	546.00	25.80	136.00	38.10	15.00
2010	143.00	981.00	104.00	361.00	346.00	475.00	22.10	145.00	34.60	12.50
2012	141.00	1,050.00	106.00	363.00	318.00	452.00	20.40	157.00	36.10	13.20

Municipal waste production (ton/year)(10⁶)										
Year	Norway	Germany	Belgium	France	Spain	Italy	Greece	Poland	Hungary	Bulgaria
2004	1.90	48.43	5.06	32.44	25.75	31.15	4.78	9.76	4.59	4.62
2006	2.14	46.43	5.12	33.99	26.21	32.52	4.93	12.24	4.71	4.39
2008	2.32	48.37	5.13	34.71	25.32	32.46	5.08	12.19	4.55	4.49
2010	2.30	49.24	4.97	34.54	23.77	32.44	5.92	12.03	4.03	4.09
2012	2.39	49.76	4.97	34.20	21.90	29.99	5.59	12.08	3.99	3.36
Tertiary educated people (person/year)(10⁶)										
Year	Norway	Germany	Belgium	France	Spain	Italy	Greece	Poland	Hungary	Bulgaria
2004	0.21	2.33	0.39	2.16	1.84	1.99	0.60	2.04	0.42	0.23
2006	0.21	2.29	0.39	2.20	1.79	2.03	0.65	2.15	0.44	0.24
2008	0.21	2.25	0.40	2.16	1.78	2.01	0.64	2.17	0.41	0.26
2010	0.22	2.56	0.45	2.25	1.88	1.98	0.64	2.15	0.39	0.29
2012	0.24	2.94	0.48	2.30	1.97	1.93	0.66	2.01	0.38	0.29

3. RESULTS

In this chapter, data about hazardous waste mentioned in Section 2.1 were evaluated and the results from the evaluations are interpreted.

3.1. Assessment of Hazardous Waste Production in Turkey

In order to evaluate hazardous waste management system in Turkey, it is important to know the change of hazardous waste amount from past to present and where these hazardous wastes mostly come from. Unfortunately, there is no data about hazardous waste amount for each year in Turkey. Besides, Turkey does not have historical data about the type and the location of hazardous waste production for each year.

3.1.1. Determination of Hazardous Waste Produced in Turkey

3.1.1.1. The amount of Hazardous Waste in Turkey

It is crucial to know the amount of hazardous waste in order to understand its effects on our lives and to produce solutions to its effects. Therefore, all studies about hazardous waste amount were examined and it was tried to determine how much hazardous waste was produced until now.

When the studies in hazardous waste field are examined, there is no registration about the amount of hazardous waste until 1994. According to the Turkish Statistical Institute (TURKSTAT), in 1994 and 1996, 8,000,000 and 5,200,000 tons of hazardous waste [28] were generated. However, after these years, the amount of hazardous waste decreased. According to TURKSTAT, in 2000, 1,307,000 tons of hazardous waste [29] was produced. In 2001, 2002 and 2003, according to Manufacturing Industry Survey developed by the TURKSTAT, the amount of hazardous waste was 1,200,000 tons [30]. In 2004 and 2005, 1,196,404 [29] and 2,600,000 [28] tons of hazardous waste were produced with respect to TURKSTAT. In 2006, there was no study about hazardous waste amount made by TURKSTAT or Ministry of Environment and Urbanization. However, with respect to thesis which's name is *Hazardous Waste Inventory in Turkey* written by Özge Yılmaz in 2006, the amount of hazardous waste produced annually should have been approximately 5,000,000 tons [15] and so we assume that the amount of hazardous waste was 5,000,000 tons for this year. In the study made by TURKSTAT, in 2008, 1,114,000 tons of hazardous waste [14] was generated.

After this year, we can obtain data which does not include data of mining sector from TABS made by Ministry of Environment and Urbanization and according to these data, between 2009 and 2015, 629,029, 786,418, 938,498, 1,373,384, 1,413,220 and 1,357,340 tons of hazardous waste [31] were generated (shown in Figure 3-1). Besides, we evaluated the data of TURKSTAT about the amount of hazardous waste produced in the manufacturing industry for these years in order to evaluate whether or not there is any differences between both values. We found that in 2010, 964,000 tons, in 2012, 806,364 tons and in 2014, 1,008,315 tons of hazardous waste was generated. As understood, most of the amount in 2014 in TABS comes from the manufacturing industry according to data of TURKSTAT, which is possible. However, the amount for 2010 is bigger than the amount in 2010 in TABS, which means that error was made in this year when calculating. As a conclusion, in TABS, there may be errors when hazardous waste inventory are determined [32].

Consequently, when we examine the amount of hazardous waste; we realize that until 2008 there are no records related to the amount of hazardous waste for each year. Moreover, after 2006, although the TABS has been used, still there are no records about the amount of hazardous waste in 2007 and 2012, which indicates that the inventory of hazardous waste cannot be created for each year. Apart from these, when we look at the Figure 3-1, we can see that until 2009, there are big differences in terms of the amount of hazardous waste, which means that the amount of hazardous waste should not have been calculated exactly in these years. In addition to these, although in the thesis which is written by Özge Yılmaz annual amount of hazardous waste should have been approximately 5,000,000 tons, as understood from Figure 3-1, after 2006 the amount of hazardous waste was quite small compared to this value. Therefore, we can say that after this year, the amount of hazardous waste should not have been calculated exactly or the amount of hazardous waste produced decreased significantly.

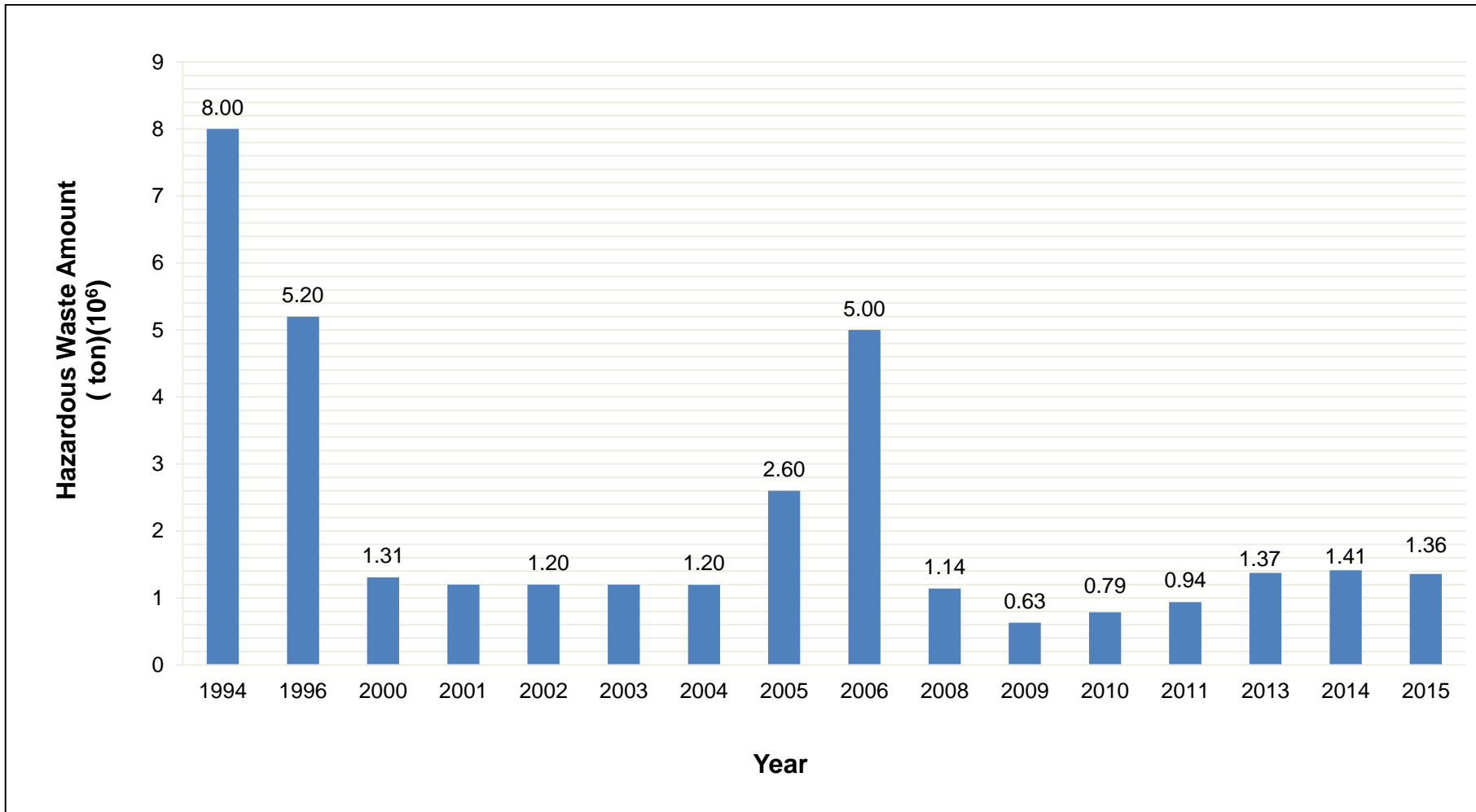


Figure 3-1: The amount of hazardous waste in Turkey over years

3.1.1.2. The amount of Hazardous Waste with respect to Business Sectors

Not only the grand total amount of hazardous waste of years but also the amount of hazardous waste distributed in business sectors is important. Therefore, in order to understand business sector distribution of hazardous waste, business sectors where most of hazardous waste produced are analyzed. According to data of TABS in 2013, business sector produced most hazardous waste was *refined petroleum product manufacturing* and second sector was *manufacturing of ferro-alloys and the main iron and steel products*, which are shown in Table 3-1 [31]. In 2014, first two business sectors become *manufacture of basic metals* and *manufacture of coke and refined petroleum products* as shown in Table 3-2 [33]. In 2015, the most hazardous waste was produced in *manufacture of basic metals*, again. However, the second sector changed and it became *manufacture of chemicals and chemical products*, which is understood from Table 3-3 [34].

Consequently, as understood from these tables, although there are differences in the order of hazardous waste of sectors, it can be said that, the most hazardous waste was produced in manufacturing of metals for these three years.

Table 3-1: Business sectors of hazardous waste produced most in Turkey in 2013 [31]

NACE Codes	Business Sectors	Hazardous Waste Amount (ton)
1920*	Refined petroleum product manufacturing	282,885
2410*	Manufacturing of ferro-alloys and the main iron and steel products	262,407
8610*	Hospital services	67,761
3030*	Manufacturing of aircraft, spacecraft and machines related to these	47,760
2451*	Iron casting	44,867
3822*	Reclamation and disposal of hazardous waste	42,695
3832*	Recovery of the disaggregated materials	42,196
2932*	Manufacturing of parts and accessories for motor land vehicles	31,640
TOTAL		822,211

Table 3-2: Business sectors of hazardous waste produced most in Turkey in 2014 [33]

NACE				Hazardous Waste Amount (ton)
Section	Section Title Definition	Segment Code	Segment Code Definition	
C	Manufacturing	24	Manufacture of basic metals	452,998
C	Manufacturing	19	Manufacture of coke and refined petroleum products	100,281
C	Manufacturing	20	Manufacture of chemicals and chemical products	97,263
Q	Human Health and Social Work Activities	86	Human health activities	87,246
D	Electricity, Gas, Steam and Air Conditioning supply	35	Electricity, Gas, Steam and Air Conditioning supply	71,825
C	Manufacturing	30	Manufacture of other transport equipment	68,588
C	Manufacturing	29	Manufacture of motor vehicles, trailers and semi-trailers	61,433

NACE				Hazardous Waste Amount (ton)
Section	Section Title Definition	Segment Code	Segment Code Definition	
C	Manufacturing	25	Manufacture of fabricated metal products, except machinery and equipment	60,103
E	Water Supply; Sewerage, Waste Management and Remediation Activities	38	Waste Collection, treatment and disposal activities; materials recovery	56,283
C	Manufacturing	13	Manufacture of textiles	46,089
TOTAL				1,102,099

Table 3-3: Business sectors of hazardous waste produced most in Turkey in 2015 [34]

NACE				Hazardous Waste Amount (ton)
Section	Section Title Definition	Segment Code	Segment Code Definition	
C	Manufacturing	24	Manufacture of basic metals	459,885
C	Manufacturing	20	Manufacture of chemicals and chemical products	98,079
Q	Human Health and Social Work Activities	86	Human health activities	84,849
D	Electricity, Gas, Steam and Air Conditioning supply	35	Electricity, Gas, Steam and Air Conditioning supply	74,473
C	Manufacturing	29	Manufacture of motor vehicles, trailers and semi-trailers	72,741
C	Manufacturing	30	Manufacture of other transport equipment	63,228
C	Manufacturing	25	Manufacture of fabricated metal products, except machinery and equipment	60,086

NACE				Hazardous Waste Amount (ton)
Section	Section Title Definition	Segment Code	Segment Code Definition	
E	Water Supply; Sewerage, Waste Management and Remediation Activities	38	Waste Collection, treatment and disposal activities; materials recovery	54,013
C	Manufacturing	28	Manufacture of machinery and equipment n.e.c.	45,528
C	Manufacturing	27	Manufacture of electrical equipment	35,691
TOTAL				1,048,573

3.1.2. Assessment of Hazardous Waste from Related Information

According to the current regulations in Turkey, information on the amount of hazardous waste produced must be provided by their producers. Therefore, a validity system must also be developed. In addition to the current mechanisms, validity of previous data must also be evaluated. There are several ways of estimating the amount of hazardous waste. One direct approach may be to investigate the correlations between hazardous waste production and other social or economical parameters. In this research, correlation between changes in population, gross national product, industrial production, municipal waste production, the number of tertiary educated people of countries and the production of hazardous waste amount is investigated for Turkey and ten European countries we have identified. The results are used to develop a method to predict the hazardous waste amount of Turkey. Although the data about number of firms using TABS were evaluated, it was not used to develop the method because it is a data set which is useful only for Turkey.

3.1.2.1. Companies and Hazardous Waste Evaluation

In Turkey, in order to determine hazardous waste inventory, the companies generating hazardous waste are determined and so, the number of companies are determined. In Turkey, before 2006, Waste Declaration Form, which is a manual voluntary system, was used by companies to inform the Ministry. After 2006, Hazardous Waste Declaration System was used by companies. The number of companies using Waste Declaration Form and Hazardous Waste Declaration System is shown in Figure 3-2.

According to Waste Declaration Form which was made by Ministry of Environment and Forestry, in 1995, the number of firm which declared their hazardous waste was 806. After this year, this number increased and it became 1,395. Between 1997 and 1999, this number decreased from year to year and it became 501, 479 and 471 respectively. However, according to survey which is developed by the State Institute of Statistics (SIS), in these years (1995-1999) the number of waste generator should have been over 10,000 but unfortunately the figure does not reflect this information [15]. In other words, the data in this figure does not give exact numbers. In 2006, Ministry started to obtain data via a new system which is called as Hazardous Waste Declaration System. In 2006, the number of firm used

this system is 600. Then, the number started to increase until 2011. Although the number of firms using TABS increased from year to year until 2011, the amount of hazardous waste did not increase with respect to this. After 2009, respectively, the numbers of companies were 6,500, 11,450, 15,664 and 18,685, which means that the number of firms using TABS and the amount of hazardous waste show parallelism with each other. In 2011, the number of firms used TABS fell slightly and the parallelism broken down. Afterwards, the number started to increase again. In 2012, the number became 21,692 and in 2013, the number became 32,801 and in 2014, the number became 39,134 and so the parallelism was established again [30]. Lastly, in 2015, although the number of companies increased and became 44,922, the amount of hazardous waste decreased and so, the parallelism broken down, again.

As understood from Table 3-4, there is no exact relationship between the amount of hazardous waste and the number of companies declaring hazardous waste according to the data of Turkey.

Table 3-4: The number of companies declaring the amount of hazardous waste by years in Turkey

Year	Hazardous waste (ton)	The number of companies declaring the amount of hazardous waste
1996	5,200,000	1,395
2006	5,000,000	600
2008	1,140,000	11,450
2009	629,029	15,664
2010	786,418	18,685
2011	938,498	18,428
2013	1,373,384	32,801
2014	1,413,220	39,134
2015	1,357,340	44,922

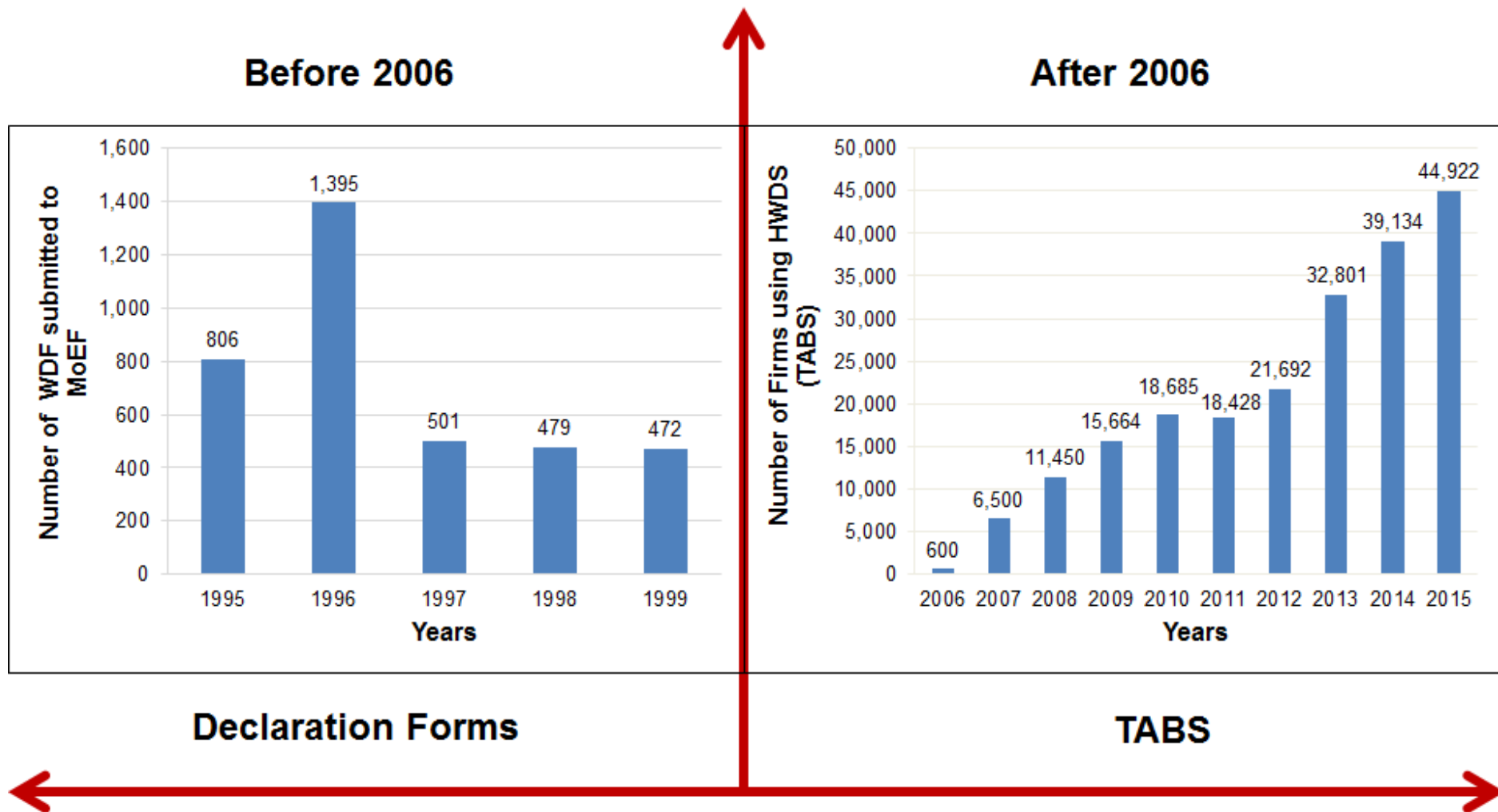


Figure 3-2: The number of companies declaring hazardous waste amount by years

3.1.2.2. Population and Hazardous Waste Evaluation

In order to reveal the overall picture of the interaction between population and hazardous waste amount, we examined population and hazardous waste amount data in 2004, 2006, 2008, 2010 and 2012 which were taken from Eurostat data portal for ten European countries. Besides, due to differences in data set, we put the data obtained from Turkey's data and the data obtained from Eurostat and so we can see the Turkey's situation among these countries.

When we looked at the Figure 3-3 [1], although we can not say that population effects hazardous waste amount positively or negatively for all countries, except for France and Italy, we can say that population effects hazardous waste amount in a uniformly distributed field for all countries, except for Turkey. Apart from these, by looking the trend line, we can say that except Bulgaria, Belgium and Turkey, there may be an effect of population on hazardous waste production.

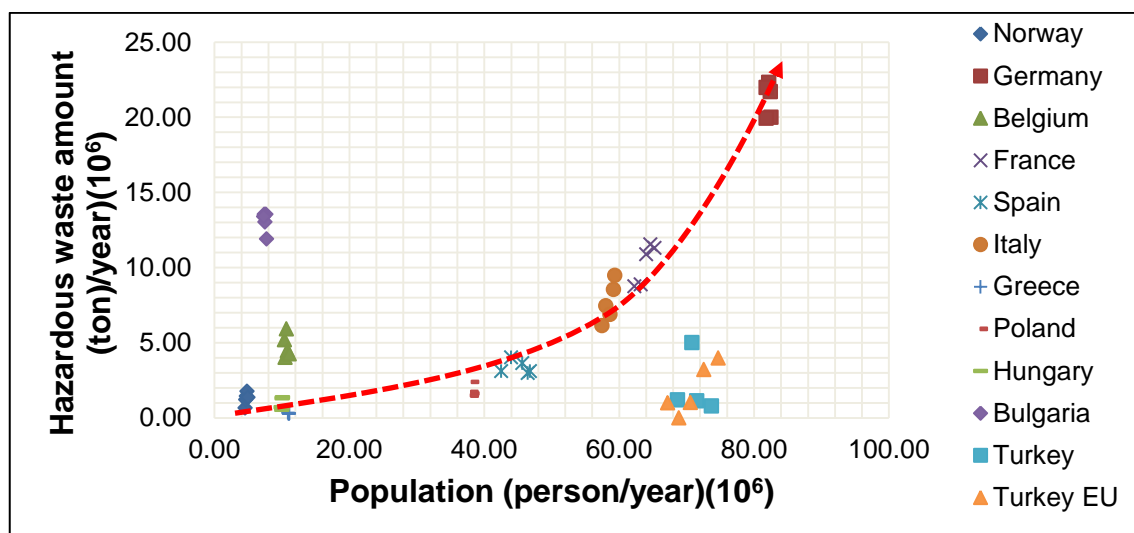


Figure 3-3: The trend line of hazardous waste production and Population interaction among European countries

When we investigated these data by using all relation types, we obtained Figure A-1 in Appendix-A and we found that there may be linear relation in only two countries which are France and Italy because their R^2 value is bigger than 0.75, which is our reference R^2 value. However, we can say that in terms of polynomial relation, population has a huge effect on hazardous waste amount in comparison with linear relation because when we looked at the Figure A-1, we can see that there is polynomial relation in Norway, France, Spain, Italy, Greece and Hungary.

As a result of these, we can say that population may affect hazardous waste amount in terms of polynomial.

In order to understand the effect of population on hazardous waste inventory in Turkey, we examined the amount of hazardous waste with respect to population parameter and as a result, we can see that the population increases from year to year but the amount of hazardous waste does not increase as shown in Table 3-5. Until 2009, the amount of hazardous waste decreases but after this year, the amount of hazardous waste starts to increase, except 2015. When we proportioned the amount of hazardous waste to population, we can see that the ratio decreases until 2009 and then, the ratio starts to increase from 2010 to 2014 as shown in Figure 3-4, which means that until 2010, the amount of hazardous waste generated per person decreases and it starts to increase in 2010. However, in 2015, the amount of hazardous waste per person decreases again.

Table 3-5: Hazardous waste-Population interaction over years in Turkey [35], [36], [37]

Year	Population (person/year)	Hazardous waste amount (ton/year)	Hazardous waste amount/Population (ton/person)
2000	67,853,315	1,307,850	0.0193 = 19,3 kg/person
2004	68,697,333	1,196,404	0.0170 = 17 kg/person
2006	70,837,305	5,000,000	0.0168 = 16.8 kg/person
2008	71,517,100	1,140,000	0.0159 = 15.9 kg/person
2009	72,561,312	629,029	0.0087 = 8.7 kg/person
2010	73,722,988	786,418	0.0107 = 10.7 kg/person
2011	74,724,269	938,498	0.0126 = 12.6 kg/person
2013	76,667,864	1,373,384	0.0179 = 17.9 kg/person
2014	77,695,904	1,413,220	0.0182 = 18.2 kg/person
2015	78,741,053	1,357,340	0.0172 = 17.2 kg/person

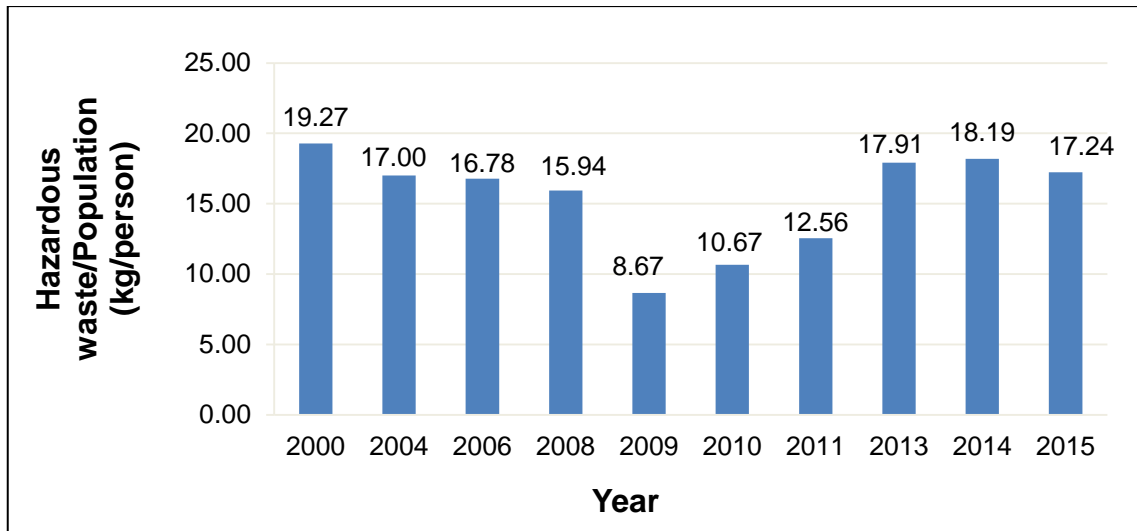


Figure 3-4: The amount of hazardous waste per capita in accordance with years in Turkey

In order to understand the relation between hazardous waste amount and population, we created linear and polynomial charts as shown in Figure 3-5 and we examined R^2 values of these charts. As a result, we found that there is neither linear nor polynomial relation between hazardous waste amount and population. Therefore, we excluded data in 2006 because it is outlier and we obtained Figure 3-6. As understood from the Figure 3-6, there is no linear relation between these values. Besides, R^2 value of polynomial is not bigger than 0.75, which means that there is not exactly polynomial relation between population and hazardous waste amount. As a result of this, we can say that there is no linear and polynomial relation between population and hazardous waste production according to the data of Turkey.

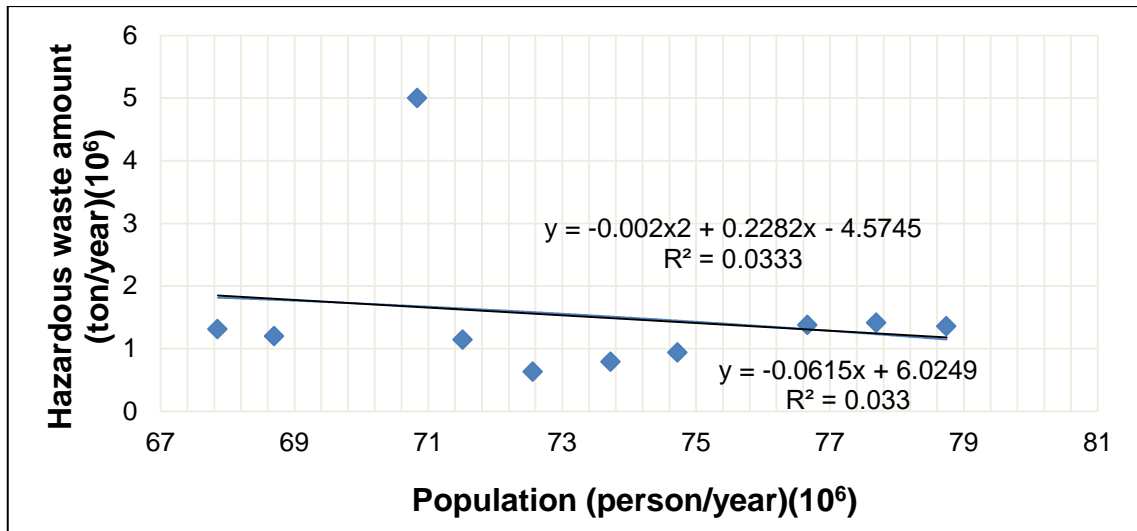


Figure 3-5: Hazardous waste amount with respect to Population in Turkey

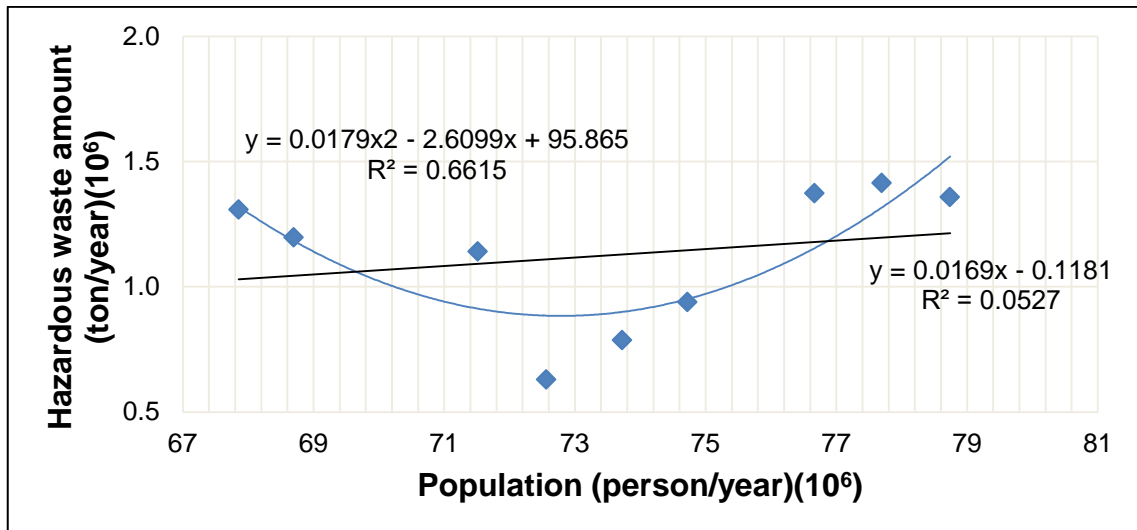


Figure 3-6: Hazardous waste amount with respect to Population in Turkey (Excluding data in 2006)

3.1.2.3. Gross Domestic Product and Hazardous Waste Evaluation

In this part, we examined Gross Domestic Product (GDP) which was calculated in terms of Purchasing Power Parity Indicators and hazardous waste amount data in 2004, 2006, 2008, 2010 and 2012 which were taken from Eurostat data portal for ten European countries because this parameter affects the consumption rate in many field like technology, health, etc. in any countries, which may affect the production of hazardous waste. Therefore, we revealed the overall picture of the interaction between GDP and hazardous waste amount. Apart from this, due to

differences in data set, we put the data obtained from Turkey's data and the data obtained from Eurostat and so we can see the Turkey's situation among these countries.

When we looked at the Figure 3-7 [1], [38], we can see that although the GDP value of Bulgarian is smaller than other countries, the amount of hazardous waste which was generated is bigger than other countries, except Germany. Besides, we can see that Germany has the biggest GDP value and also, most hazardous waste was generated in Germany. In addition to these, when we examined all countries, the distribution of hazardous waste amount with respect to GDP is around the trend line, which means that there may be an effect of GDP on hazardous waste production.

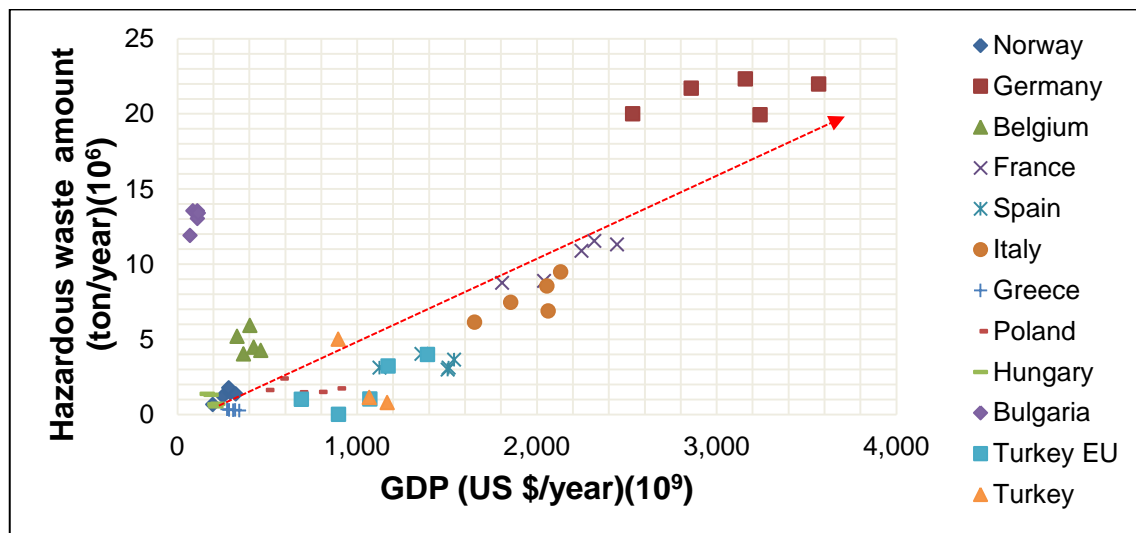


Figure 3-7: The trend line of hazardous waste production and GDP interaction among European countries

When we investigated these data by using all relation types, we obtained Figure A-2 in Appendix-A and we found that there is linear relation for France, Greece and Hungary and also there is polynomial relation for Norway, France, Greece, Hungary and Bulgaria between GDP and hazardous waste amount. In the light of this information, the possibility of polynomial effect of GDP on hazardous waste is higher than linear effect and so, we can say that there may be polynomial relation between these values.

When we examined the amount of hazardous waste with regard to GDP in Turkey, we can see that GDP increases, except 2009, as understood from Table 3-6. However, this situation is not valid for hazardous waste production. When we

evaluated hazardous waste production per GDP, we can see that the ratio decreases sharply until 2009. After 2009, it changes from year to year.

Table 3-6: Hazardous waste-GDP interaction by years in Turkey [39]

Year	Hazardous waste amount (ton/year)	GDP (Gross Domestic Product) (US \$/year)	Hazardous waste amount/GDP (ton/US \$)
2006	5,000,000	894,971,200,000	0.00000559 = 5.59 g/ US \$
2008	1,140,000	1,067,943,800,000	0.00000107 = 1.07 g/ US \$
2009	629,029	1,044,056,200,000	0.00000060 = 0.6 g/ US \$
2010	786,418	1,168,956,700,000	0.00000067 = 0.67 g/ US \$
2011	938,498	1,308,343,100,000	0.00000072 = 0.72 g/ US \$
2013	1,373,384	1,451,518,000,000	0.00000095 = 0.95 g/ US \$
2014	1,413,220	1,502,524,800,000	0,00000094 = 0.94 g/ US \$
2015	1,357,340	1,542,572,890,900	0,00000088 = 0.88 g/ US \$

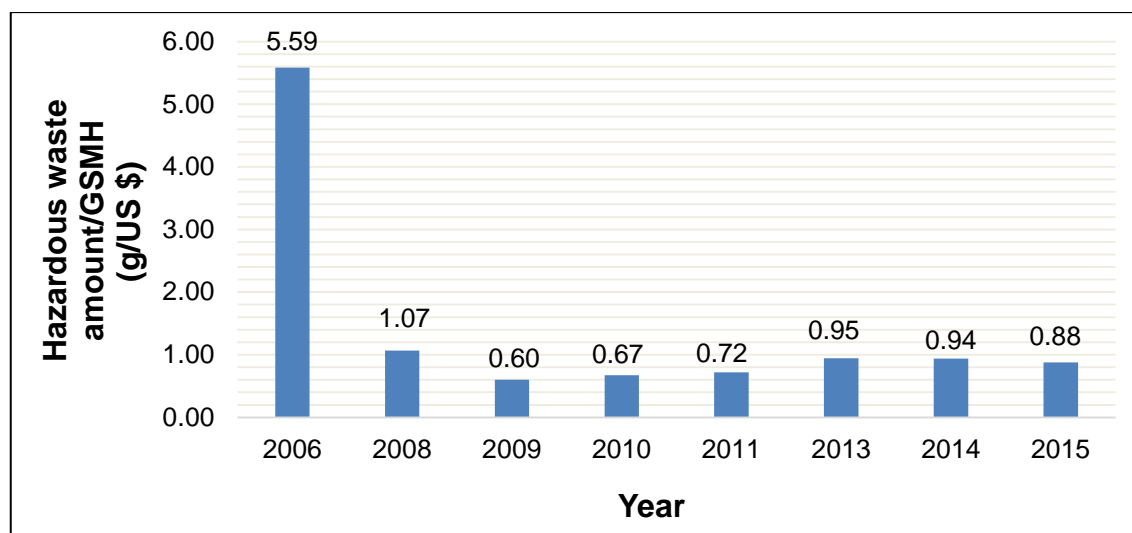


Figure 3-8: The ratio of the amount of hazardous waste to GDP accordance with years in Turkey

In order to understand the relation between hazardous waste production and GDP, we created charts and found that there is not linear relation but there is polynomial relation between these values. Although we found a relation between these values, we analyzed the relation again in order to obtain strong relation by excluding the hazardous waste value in 2006 because it is outlier, and we found that there is no relation between these values because the R^2 value of linear chart and polynomial chart is smaller than 0.75. Consequently, we can say that there is polynomial relation between these values.

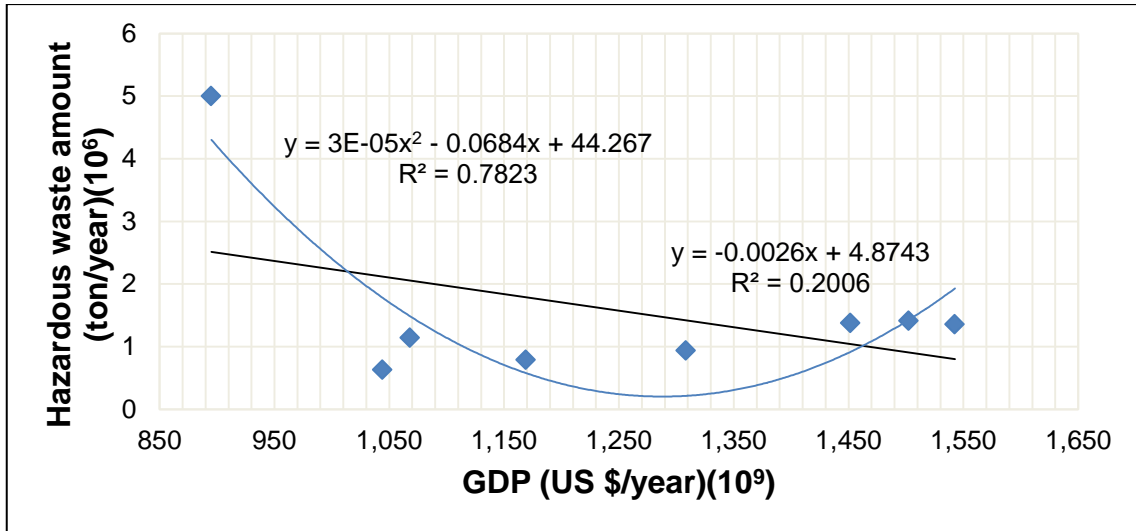


Figure 3-9: Hazardous waste amount with respect to GDP in Turkey

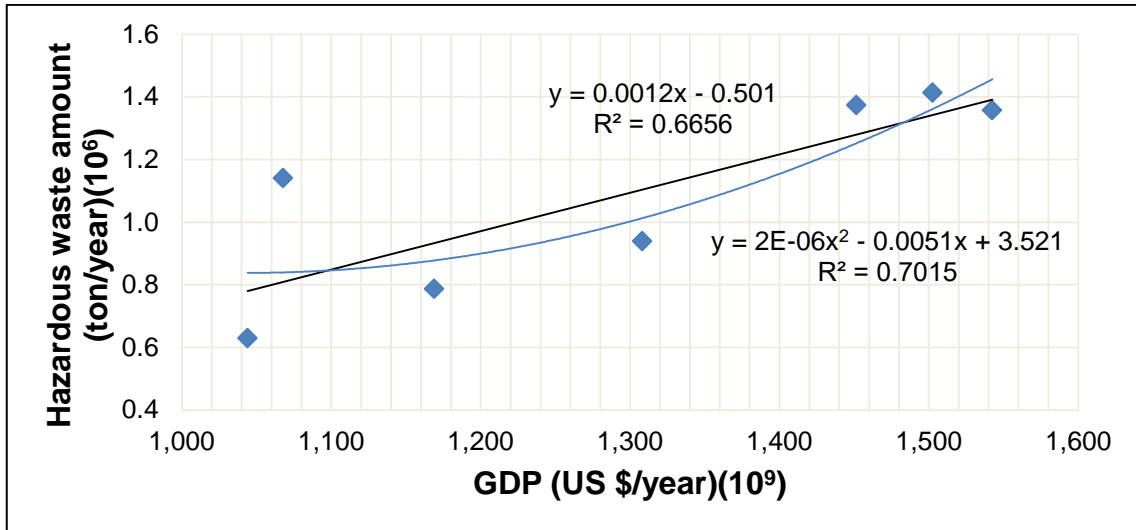


Figure 3-10: Hazardous waste amount with respect to GDP in Turkey
(Excluding the value in 2006)

3.1.2.4. Industrial Production and Hazardous Waste Evaluation

In this part, we examined industrial production (the production value of industrial products) and hazardous waste amount data in 2004, 2006, 2008, 2010 and 2012 which were taken from Eurostat data portal for ten European countries because this parameter affects industrial consumption. Therefore, we revealed the overall picture of the interaction between industrial production and hazardous waste amount. Besides, due to differences in data set, we put the data obtained from

Turkey's data and the data obtained from Eurostat, again and so we can see the Turkey's situation among these countries.

When we looked at the Figure 3-11 [1], [40], we can see that Germany has highest industrial production values and so, it produced the most hazardous waste. However, even though Bulgaria has low industrial productions, the amount of hazardous waste is much more than the others'. In addition to these, we can say that industrial production may affects hazardous waste production, except Bulgaria, because the hazardous waste values accordance with industrial production gather around the trend line.

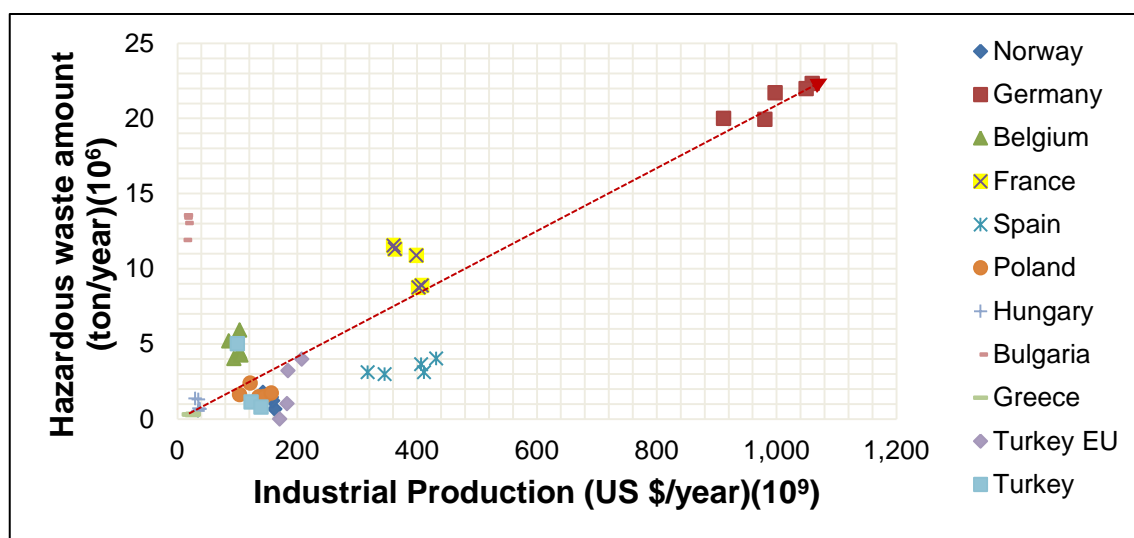


Figure 3-11: The trend line of hazardous waste production and industrial production interaction among European countries

When we investigated these data by using all relation types, we obtained Figure A-3 in Appendix-A and we found that there is linear relation for Germany and Italy, and also, there is polynomial relation for Norway, Germany, France and Italy because their R^2 values are bigger than 0.75 and also, their values are closer to 1. As a result of these, we can say that there may be polynomial relation between hazardous waste and industrial production.

The relationship between the hazardous waste amount and industrial production is investigated for the data of Turkey. The data showed that except in 2009, the industrial production increases year by year. However, this is not valid for hazardous waste production as shown in Table 3-7. Also, as understood from the Figure 3-12, the hazardous waste amount per industrial production sharply

decrease after 2006 and it decrease until 2013. After 2013, it changes from year to year.

Table 3-7: Hazardous waste-Industrial Production interaction by years in Turkey [41]

Year	Hazardous waste amount (ton/year)	Industrial production (Production value of Industrial Products) (US \$/year)	Hazardous waste amount/Industrial production (ton/US \$)
2005	2,600,000	82,092,218,535	0.0000317 = 31.7 g/US \$
2006	5,000000	100,323,075,642	0.0000498 = 49.8 g/US \$
2008	1,140,000	123,187,811,313	0.0000093 = 9.3 g/US \$
2009	629,029	110,541,716,967	0.0000057 = 5.7 g/US \$
2010	786,418	139,840,776,212	0.0000056 = 5.6 g/US \$
2011	938,498	192,614,591,804	0.0000049 = 4.9 g/US \$
2013	1,373,384	233,749,386,661	0.0000059 = 5.9 g/US \$
2014	1,413,220	278,584,395,845	0.0000051 = 5.1 g/US \$
2015	1,357,340	298,921,836,205	0.0000045 = 4.5 g/US \$

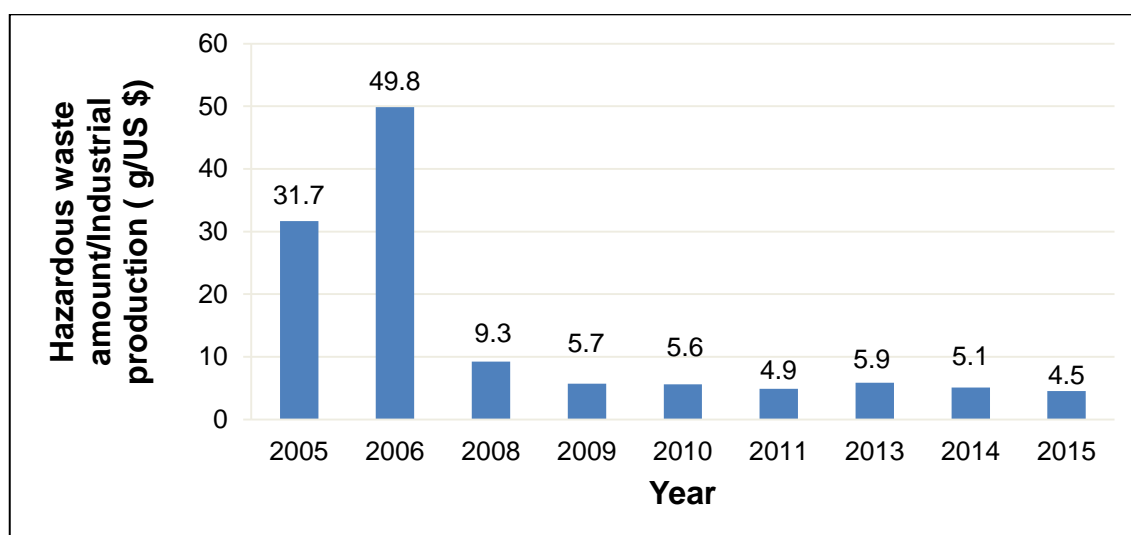


Figure 3-12: The ratio of the amount of hazardous waste to Industrial production in accordance with years in Turkey

When we examined the relation between industrial production and hazardous waste amount, we can understand from Figure 3-13, there is no direct relation between them because the value of R^2 is not close to 1. Due to the hazardous waste amount in 2006 which is outlier, we analyzed the relation again by excluding the value in 2006 and we found that the value of R^2 decreases as shown in Figure 3-14, which means that there is no relation between them. However, the industrial production may not affect the hazardous waste production linearly. Therefore, we

created polynomial chart as shown in Figure 3-13 and Figure 3-14 and we found that the R^2 vales are not very close to 1. As a result of this, we can say that with respect to the data of Turkey, industrial production does not affect hazardous waste production.

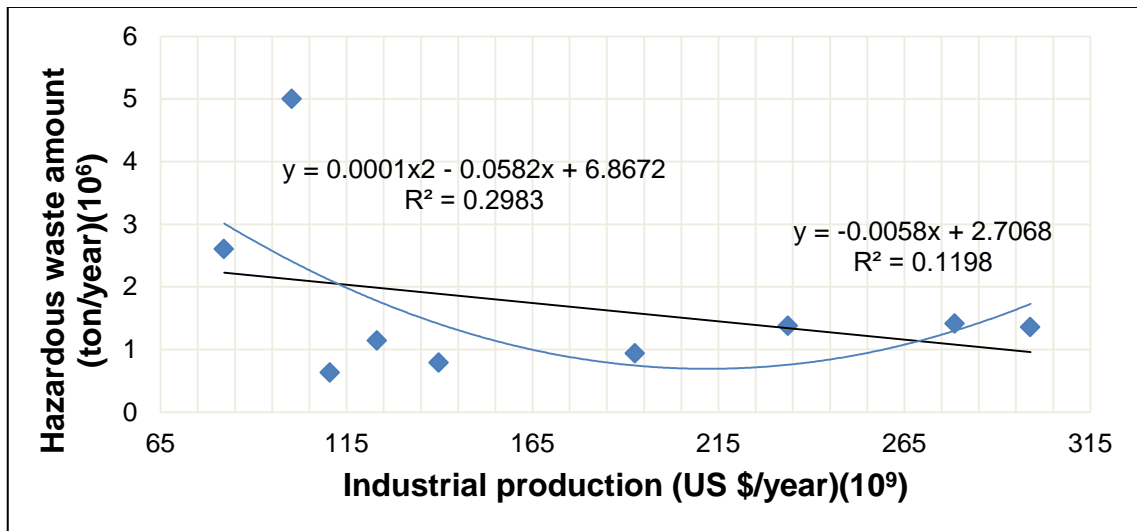


Figure 3-13: Hazardous waste amount with respect to Industrial production in Turkey

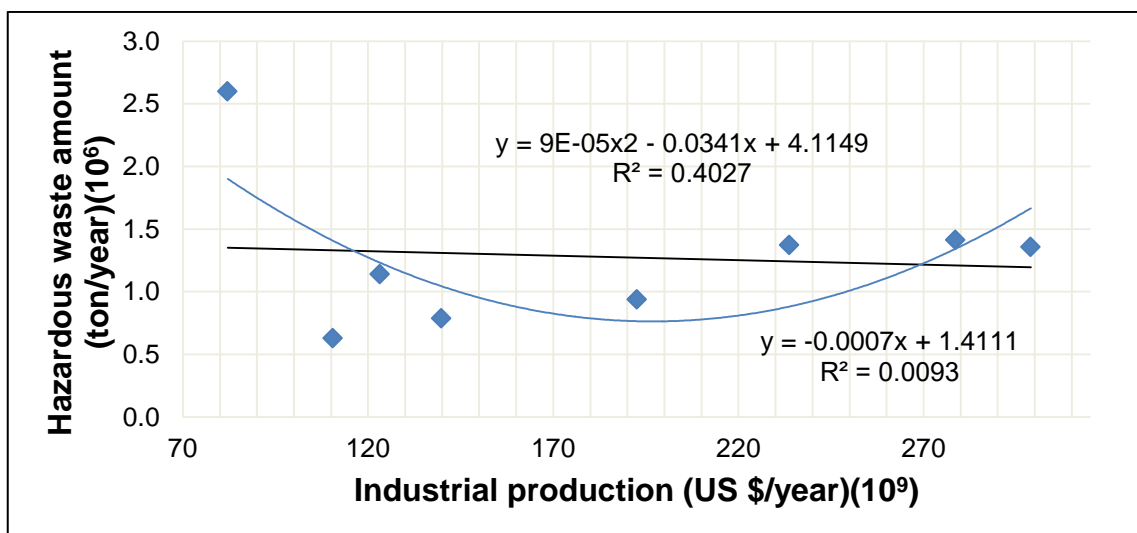


Figure 3-14: Hazardous waste amount with respect to Industrial production in Turkey (Excluding the value in 2006)

3.1.2.5. Municipal Waste and Hazardous Waste Production Evaluation

In this part, in order to reveal the overall picture of the interaction between municipal waste and hazardous waste production, we examined municipal and

hazardous waste amount data in 2004, 2006, 2008, 2010 and 2012 which were taken from Eurostat data portal for ten European countries because there is an impact of municipal waste production on hazardous waste production. Besides, due to differences in data set, we put the data obtained from Turkey's data and the data obtained from Eurostat and so we can see the Turkey's situation among these countries.

According to Figure 3-15 [1], Germany has the most municipal and hazardous waste production, and Bulgaria has more hazardous waste amount compared to other countries' in spite of having less municipal waste amount than most of them. In addition to these, we can see that there may be a relation between hazardous waste and municipal waste production because the distribution of these values for most of countries, except Bulgarian, is around the trend line.

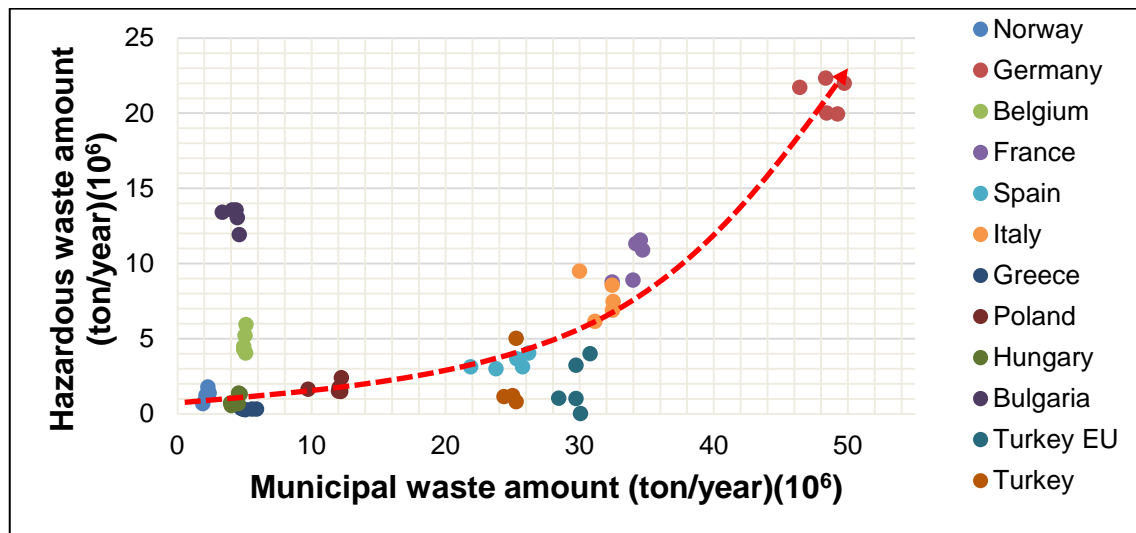


Figure 3-15: The trend line of hazardous waste and municipal waste production interaction among European countries

When we investigated these data by using all relation types, we obtained Figure A-4 in Appendix-A and we found that there is no linear relation for any of the countries. However, there is polynomial relation for Norway, Italy and Bulgaria. Therefore, by looking these results, we can say that there may be no linear relation between these values but there may be polynomial relation.

In the light of these information, we examined the hazardous waste amount with respect to municipal waste amount for Turkey and we found that until 2004, the amount of municipal waste increases but the amount of hazardous waste

decreases and in 2001, 2002 and 2003, it remains constant. In 2004, both values decrease and in 2006, both values increase. Then, in 2008, the municipal waste amount again decreases and the hazardous waste decreases, too. After that, the municipal waste amount continues to increase but this situation is not valid for hazardous waste amount, which is shown in Table 3-8. As understood from this, there is no exact parallelism between these values. In addition to these, when we looked at the Figure 3-16, we can see that until 2004, the amount of hazardous waste generated per municipal waste amount decreases. After 2003, it increases and in 2008, again it decreases until 2014.

In order to understand the relation between the amount of hazardous waste and municipal waste we created linear chart and polynomial chart as shown in Figure 3-17, and so we saw that although the R^2 value of polynomial chart is greater than linear charts', we can not say there is linear or polynomial relation between these values because the value of R^2 is smaller than 0.75, which means that there is no effects of municipal waste production on hazardous waste production.

Table 3-8: Hazardous waste-Municipal waste interaction by years in Turkey [39]

Year	Hazardous waste amount (ton/year)	Municipal waste amount (ton/year)	Hazardous waste amount/Municipal waste amount (ton/ton)
1994	8,000,000	17,757,000	0.4505
1996	5,200,000	22,483,000	0.2313
2001	1,200,000	25,134,000	0.0477
2002	1,200,000	25,373,000	0.0473
2003	1,200,000	26,118,000	0.0459
2004	1,196,404	25,014,000	0.0478
2006	5,000,000	25,280,000	0.1978
2008	1,140,000	24,361,000	0.0468
2010	786,418	25,277,000	0.0311
2014	1,413,220	28,011,000	0.0505

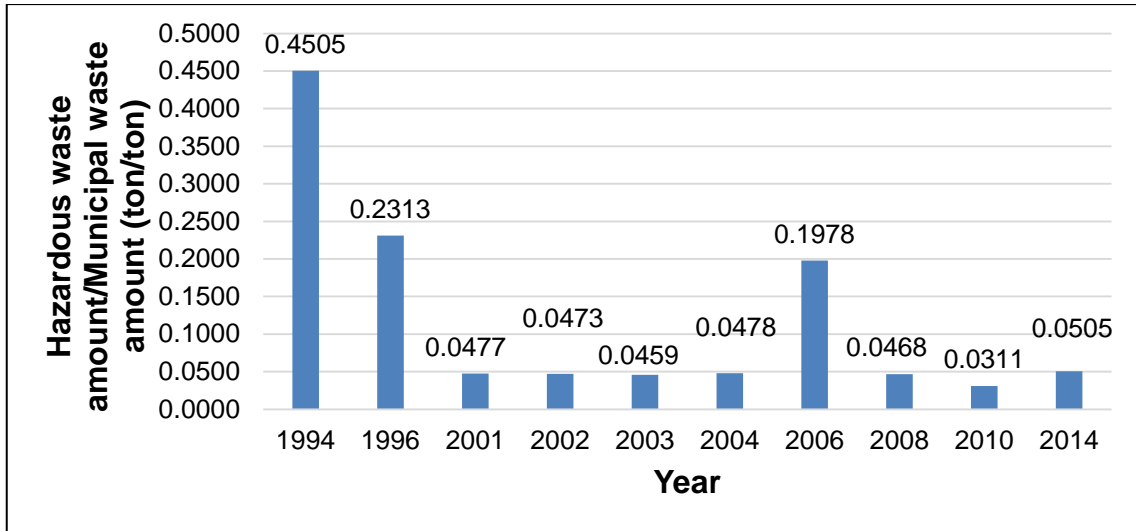


Figure 3-16: The ratio of the amount of hazardous waste to municipal waste in accordance with years in Turkey

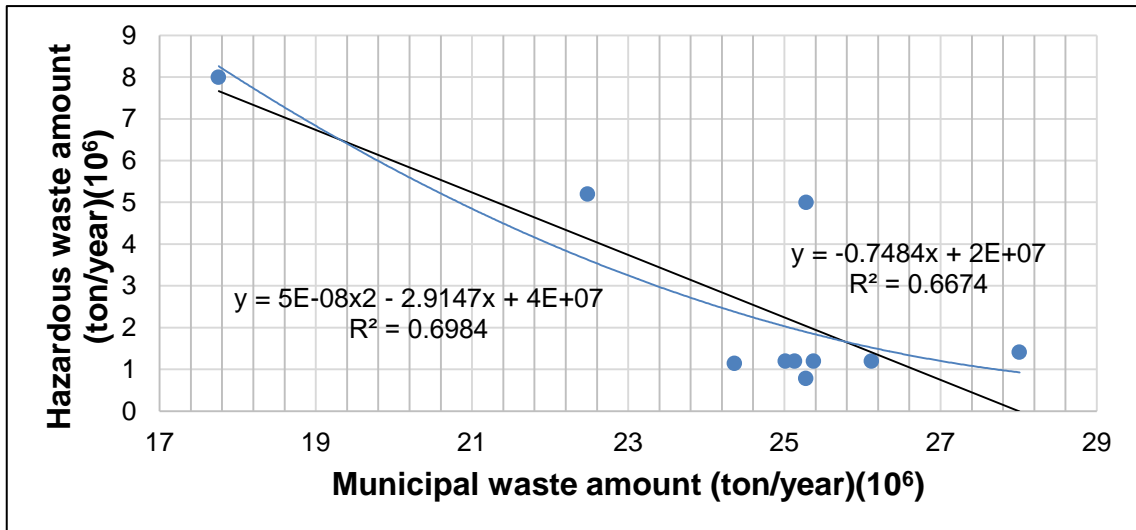


Figure 3-17: Hazardous waste amount with respect to municipal waste in Turkey

3.1.2.6. Tertiary Educated People and Hazardous Waste Evaluation

In this part, in order to understand whether or not there is an impact of education on hazardous waste amount, we examined the number of tertiary educated people and hazardous waste amount data in 2004, 2006, 2008, 2010 and 2012 which were taken from Eurostat data portal for ten European countries. However, we did not evaluate hazardous waste amount directly with respect to the number of tertiary educated people because the change in the population affects it directly. Therefore, we evaluated it with respect to tertiary educated people/population

ratio. Apart from this, due to differences in data set, we put the data obtained from Turkey's data and the data obtained from Eurostat and so we can see the Turkey's situation among these countries.

When we looked at the Figure 3-18 [1], we can see that the data of other countries gather around the trend line, which means that the number of tertiary educated people may affect hazardous waste production.

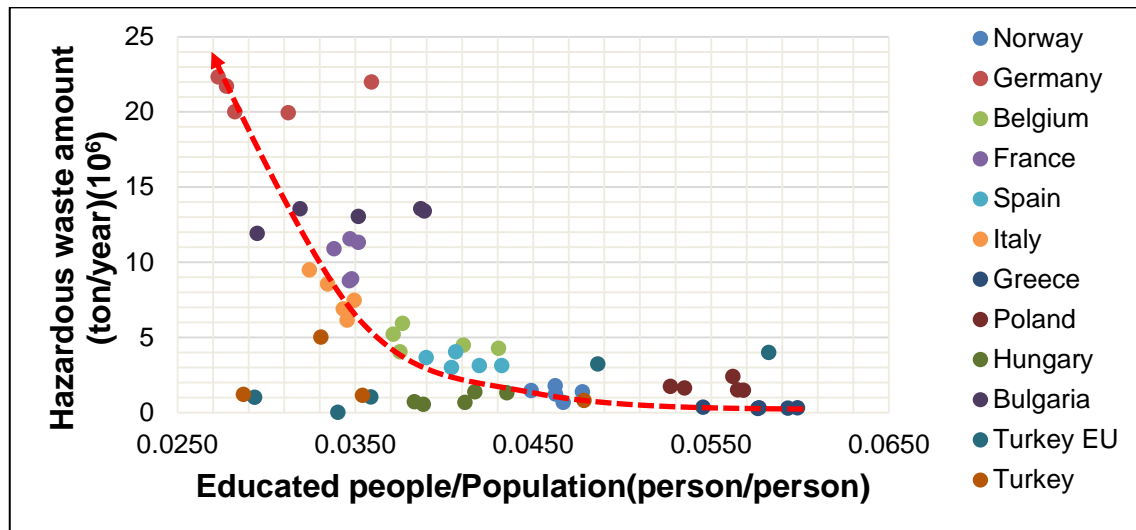


Figure 3-18: The trend line of hazardous waste amount and tertiary educated people/population interaction among European countries

When we investigated these data by using all relation types, we obtained Figure A-5 in Appendix-A and we found that there is no linear relation for any of the countries but there is polynomial relation only for Italy and Greece. As a result of these, we can say that there may be polynomial relation between these values instead of linear relation.

In order to understand the effect of tertiary education on hazardous waste amount in Turkey, firstly we created Table 3-9 and we saw that although the ratio of tertiary educated people with respect to population increases by years but the amount of hazardous waste does not increase and there are fluctuations in 2006 and 2009. Secondly, we created linear and polynomial charts as shown in Figure 3-19 and we saw that there is no linear and polynomial relation between these values because the R^2 values of charts are smaller than 0.75. Therefore, we excluded the data in 2006 due to being outlier and we created another linear and polynomial charts as shown in Figure 3-20 so that, we found that despite tertiary

education does not affect the hazardous waste amount linearly, there is an impact of tertiary education on hazardous waste amount in terms of polynomial because of the value of R^2 . Consequently, we can say that the number of tertiary educated people may affect the hazardous waste amount in terms of polynomial.

Table 3-9: Hazardous waste-(Tertiary Educated People/Population) interaction over years in Turkey [42] [43]

Year	Hazardous waste (ton/year)	Population (person/year)	Tertiary Educated People (person/year)	Tertiary Educated People/Population
2000	1,307,850	67,853,315	1,503,981	0.0222
2004	1,196,404	68,697,333	1,972,662	0.0287
2006	5,000,000	70,837,305	2,342,898	0.0331
2008	1,140,000	71,517,100	2,532,622	0.0354
2009	629,029	72,561,312	2,924,281	0.0403
2010	786,418	73,722,988	3,529,334	0.0479
2011	938,498	74,724,269	3,817,086	0.0511
2013	1,373,384	76,667,864	4,975,690	0.0649
2014	1,413,220	77,695,904	5,472,521	0.0704

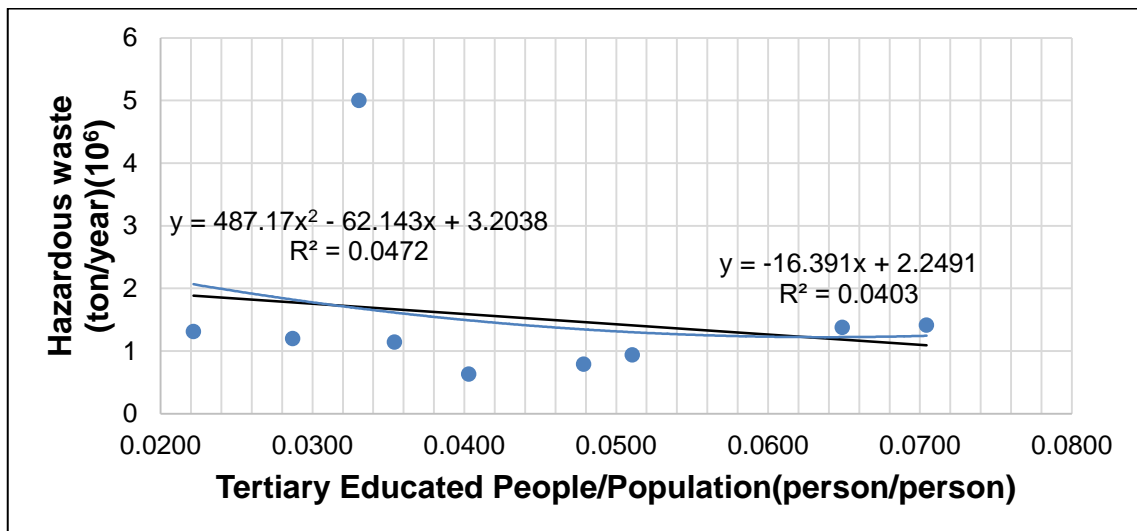


Figure 3-19: Hazardous waste amount with respect to Tertiary Educated People/Population in Turkey

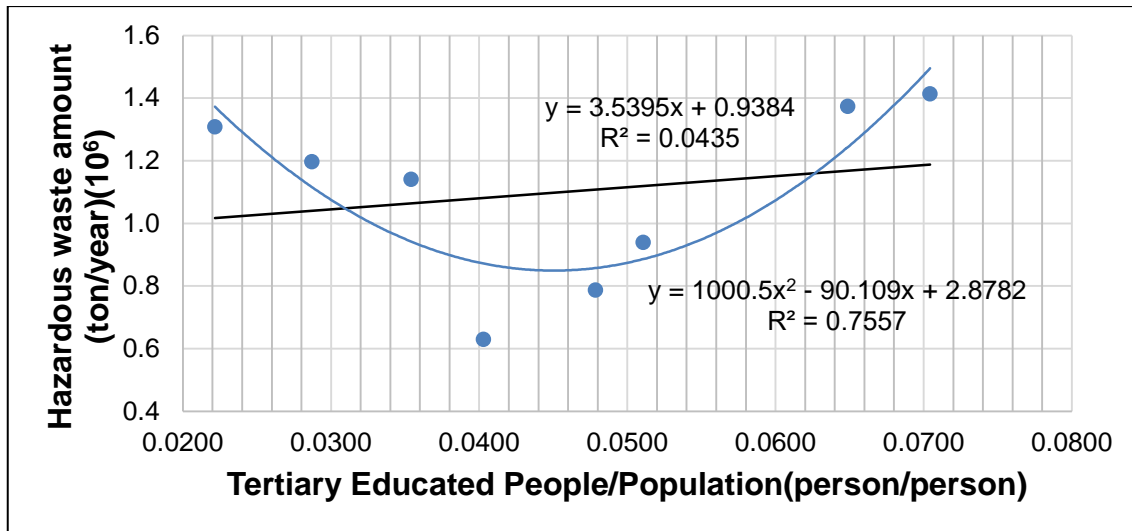


Figure 3-20: Hazardous waste amount with respect to Tertiary Educated People/Population in Turkey (Excluding the value in 2006)

3.2. Evaluation of Hazardous Waste Removal Facilities in Turkey

3.2.1. Situation of Hazardous Waste Removal Facilities

In order to manage hazardous waste, determining the hazardous waste inventory is not enough. Therefore, required methods for removal should be learned and also required hazardous waste removal facilities should be established.

When we investigate hazardous waste facilities in Turkey, we obtain that there are incineration and co-incineration facilities, landfill and recycling facilities. When we examined these facilities as numerical, we can see that in 2003, the number of incineration and co-incineration, and hazardous waste landfill was 1 but the number of hazardous waste recycling facility was 18. After this year, the number of all hazardous waste facilities increases. In 2010, the number of incineration and co-incineration becomes 33 and the number of hazardous waste landfill becomes 4. Besides, the number of hazardous waste recycling facility heavily increases and it becomes 192. In 2012, respectively, the number of facilities becomes 37, 6 and 201. After 2012, the number of facilities does not change much as shown in Graph-21. In 2015, there are 201 facilities which recycle hazardous waste, 36 facilities which incinerate hazardous waste and 8 facilities which bury hazardous waste. Actually, we do not want the increase of the number of hazardous waste incineration and landfill facilities as an environmental engineer because they are as dangerous as hazardous waste. Therefore, we prefer the recycling of hazardous waste or minimization of hazardous waste. As a result of these, the

number of hazardous waste landfill and incineration facilities should have been decreased, and the number of hazardous waste recycling facilities should have been increased. However, as understood from the Figure 3-21 [44], in recent years the number of hazardous waste recycling facilities does not increase although the amount of hazardous waste increases. This situation brings to mind the question; whether or not the current landfill and incineration facilities damage environment and also, the capacity of the existing hazardous waste recycling facilities is sufficient for the existing amount of hazardous waste.

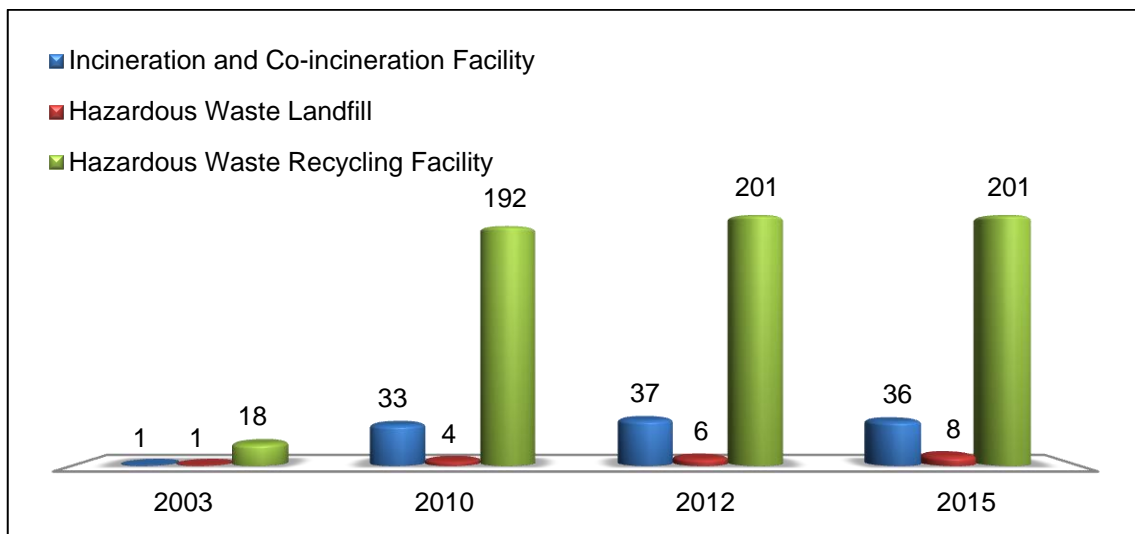


Figure 3-21: Total number of facilities by years in Turkey

In addition to these, when the number of these facilities are analyzed with respect to province as shown in Figure 3-22 and Figure 3-23 [45], most of hazardous waste removal facilities are in big cities like İstanbul, Ankara, İzmir where industry developed. Also, as understood from Figure 3-24 [45], in some provinces like Giresun, Bayburt, Trabzon, Malatya, Isparta, Muş, Bitlis, Hakkari, etc. there are not any facilities although hazardous waste is produced. Consequently, it is shown that the number of treatment facilities decreases from west to east.

Besides, when the removal facilities are investigated in accordance with permit license subjects, we can say that most of the license is about hazardous waste recycling (29 %) as shown in Figure 3-25 [45]. Moreover, as understood from the Figure 3-26 [45], the number of permit license is much more than the number of hazardous waste removal facilities, which means that one company takes permit license more than one. When we look at the Appendix-B, Table-B.1 [45], we can

see that almost all of hazardous waste landfill facilities are cement plants and, these plants use hazardous waste as additional fuel.

Apart from all these, although we could not obtain data about the total capacity of all facilities due to the rule of keeping confidential of company information, we could obtain data about the amount of hazardous waste which was sent to hazardous waste plants as shown in Table 3-10. According to waste disposal and recovery facilities statistics in 2014 made by TURKSTAT, the amount of hazardous waste which was landfilled is 5,590,323.074. In addition to this, the amount of hazardous waste incinerated and co-incinerated are 39,625.543 and 192,155.47346. Besides, the amount of hazardous waste which was recovered is 437,611.05215. After all, the total amount of hazardous waste sent to hazardous waste plants is 6,259,717.143 and this is much more than the amount of hazardous waste generated in 2014 which is 1,413,220 tons/year according to TABS. As it is understood from the amounts, there is big difference between these values in this year. In the light of this information, we can say that the hazardous waste amount may not be calculated accurately. After all, we can not know the exact reason of this situation.

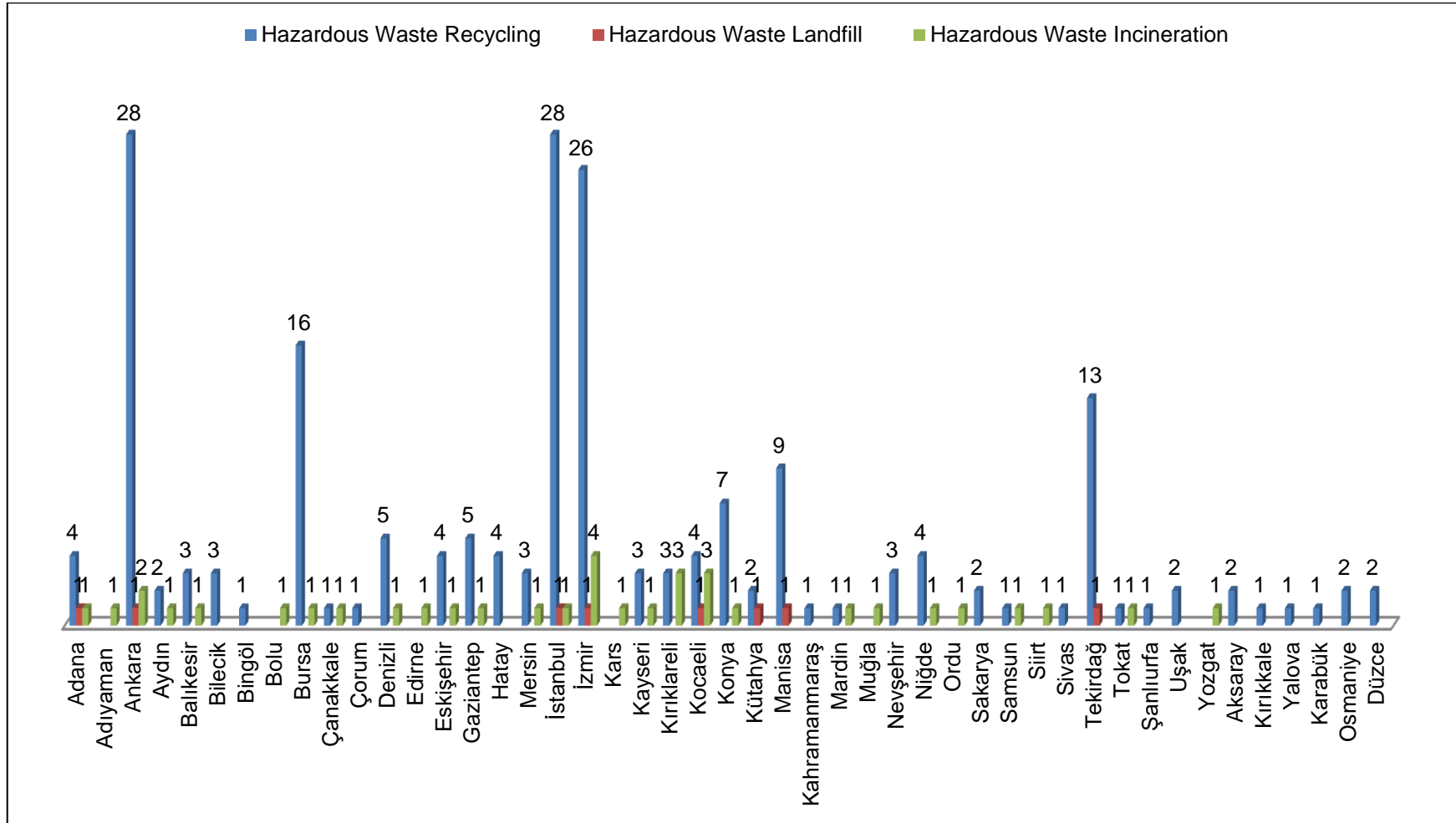


Figure 3-22: Number of hazardous waste facilities by province in Turkey in 2015



Figure 3-23: The distribution of number of hazardous waste facilities in Turkey in 2015



Figure 3-24: The distribution of hazardous waste facilities in Turkey in 2015

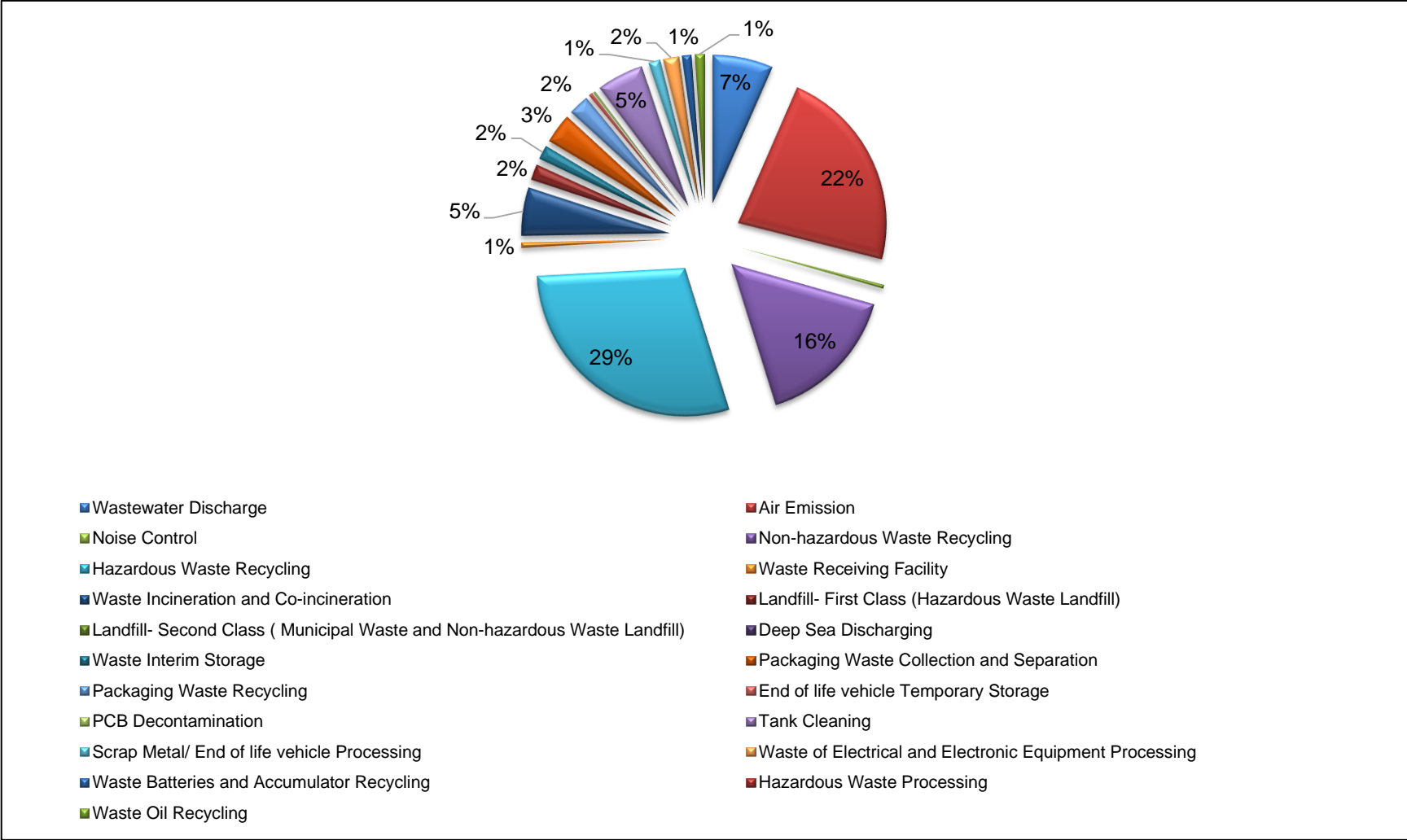


Figure 3-25: Percentage Distribution of Permit License Subjects of Facilities in Turkey in 2015

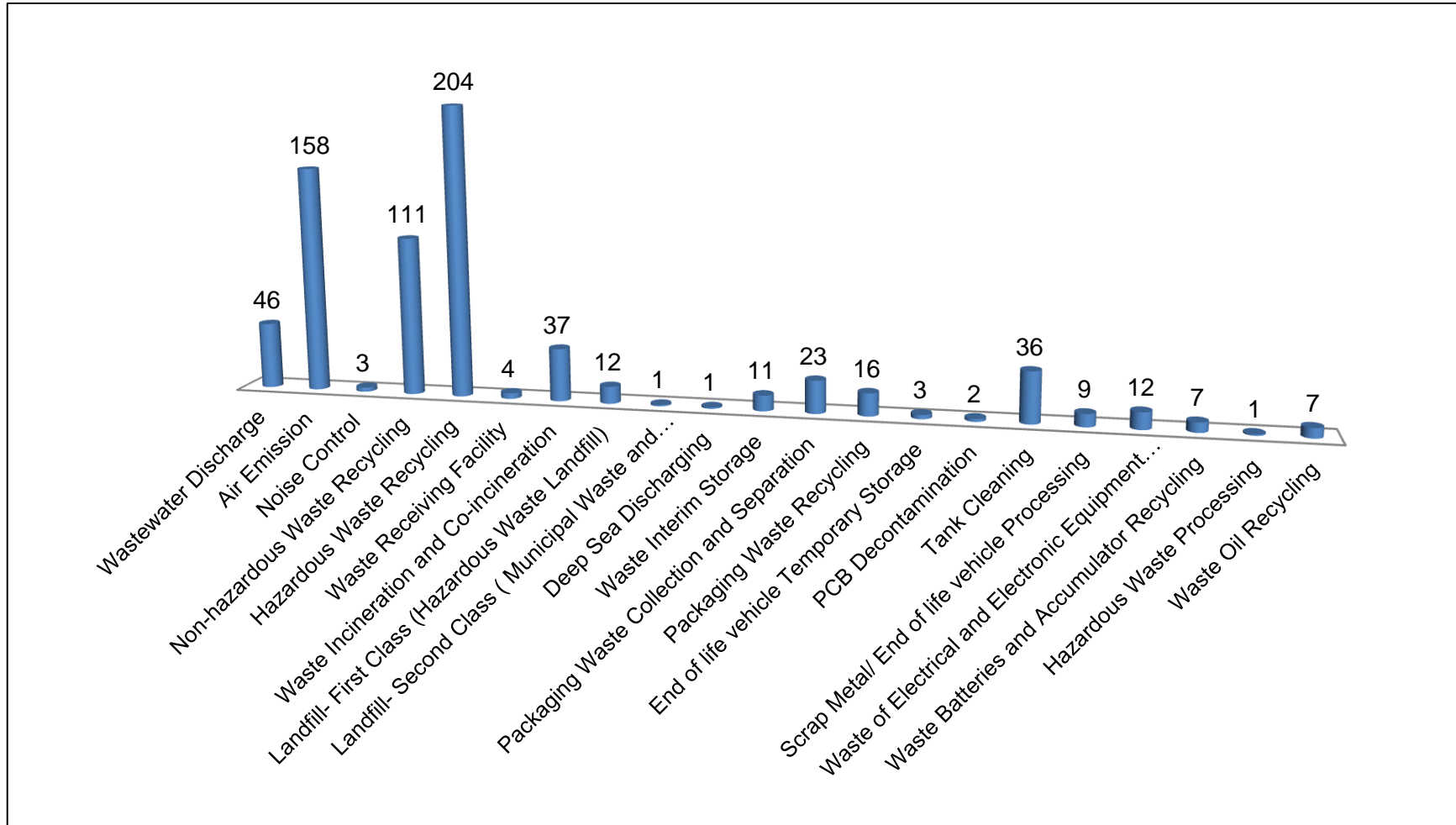


Figure 3-26: The number of permit license subjects of facilities in Turkey in 2015

Table 3-10: The amount of hazardous waste sent to hazardous waste plants in 2014 in Turkey [46]

Waste disposal and recovery facilities statistics (2014)	
The amount of hazardous waste landfilled (tons/year)	5,590,323.074
The amount of hazardous waste incinerated (tons/year)	39,625.543
The amount of hazardous waste co-incinerated (tons/year)	192,155.47346
The amount of hazardous waste recovered (tons/year)	437,611.05215
Grand Total	6,259,717.143

3.2.2. Evaluation of Hazardous Waste Removal Facilities

3.2.2.1. Hazardous Waste Removal Facilities and Development Index Evaluation

One of the most important factors affecting hazardous waste management is hazardous waste removal facilities. Therefore, it is necessary to know what external factors affect the establishment of a hazardous waste facility. As a result of this, in this part, development index were examined by considering it has effect on hazardous waste removal facilities.

In order to determine whether or not development index affects hazardous waste facilities, we evaluate the number of hazardous waste in terms of development index of provinces. When we made this, we assumed that the development indexes of provinces have not change in recent years and so, we used the development index data in 2013 determined by Türkiye İş Bankası. When Türkiye İş Bankası determine these values, it used economic and social development criteria in Table 3-11 [47].

Table 3-11: Economic and Social Development Criteria of Development Index of Provinces [47]

Economic Development Criteria	Data Source	Social Development Criteria	Data Source
Population	TURKSTAT	Air pollution	TURKSTAT
Net Migration	TURKSTAT	The rate of home ownership	TURKSTAT
Tax revenues collected	Ministry of Finance	The number of doctor	TURKSTAT
Investment incentives	Ministry of Economy	The number of hospital	TURKSTAT
The number of employees in ISO 1000	ISO	The number of beds	TURKSTAT
The number of companies in Export 1000	Turkish Exporters Assembly (TIM)	Infant death	TURKSTAT
Electricity consumption	TURKSTAT	The number of movie viewers	TURKSTAT
The number of trucks	TURKSTAT	Home sales	TURKSTAT
The number of tractors	TURKSTAT	The total number of landing and taking off (Airplane)	TURKSTAT
Exportation	TURKSTAT	The number of passengers (Airline)	TURKSTAT
Importation	TURKSTAT	Payload (Airline)	TURKSTAT
The total number of companies opened	TURKSTAT	Innovativeness (The number of patents, utility models and brands)	Turkish Patent Institute
Savings account	Banking Regulation and Supervision Agency (BRSA)	The number of students of bachelor's degree and associate degree	TURKSTAT
The number of branch bank	BRSA	The number of faculty members (The number of assistant professors, associate professors and professors)	TURKSTAT
Cash loans	BRSA	The number of ADSL subscribers	Information and Communication Technologies Authority (BTK)

Economic Development Criteria	Data Source	Social Development Criteria	Data Source
Non-performing loans ratio	BRSA	The number of fixed lines	BTK
Non-cash loans	BRSA	The number of mobile phones	BTK
The number of ATMs	The Banks Association Of Turkey (TBB)		
The number of POS	TBB		
The number of merchant	TBB		
The number of customers of interactive banking	TBB		
Vegetative production	TURKSTAT		
Animal production	TURKSTAT		
Tourism	TURKSTAT		
Population density	TURKSTAT		
Population growth	TURKSTAT		
Population rate under 15-year-old	TURKSTAT		
The number of cars	TURKSTAT		
Labor force participation rate	TURKSTAT		
Unemployment rate	TURKSTAT		
Public investment	Ministry of Development		
The number of enterprise	TURKSTAT		

When the development indexes of provinces are calculated with respect to economic and social development criteria, results in Table 3-12 [47] were obtained. As understood from Table 3-12, big cities like İstanbul, Ankara, İzmir, Antalya are more developed than other cities. Contrary to this, the development indexes of some cities like Muş, Bitlis, Siirt, Hakkari, etc. are very low.

Table 3-12: Development Indexes of Provinces in Turkey [47]

Province	Dev. Index	Province	Dev. Index	Province	Dev. Index
İstanbul	36.61	Bolu	-0.49	Giresun	-1.51
Ankara	12.41	Kütahya	-0.64	Erzincan	-1.53
İzmir	8.09	Kırklareli	-0.73	Artvin	-1.57
Antalya	7	Malatya	-0.8	Osmaniye	-1.57
Bursa	4.31	Elazığ	-0.82	Mardin	-1.6
Kocaeli	3.8	Karabük	-0.94	Tokat	-1.61
Muğla	2.69	Nevşehir	-1.01	Çankırı	-1.79
Konya	2.16	Karaman	-1.03	Sinop	-1.81
Adana	2.04	Sivas	-1.03	Niğde	-1.83
Eskişehir	1.69	Kahramanmaraş	-1.04	Tunceli	-1.89
Gaziantep	1.65	Diyarbakır	-1.09	Batman	-2.09
Denizli	1.26	Uşak	-1.11	Gümüşhane	-2.11
Kayseri	1.21	Düzce	-1.12	Bayburt	-2.12
Mersin	1.09	Kırıkkale	-1.12	Adıyaman	-2.17
Tekirdağ	1.09	Afyonkarahisar	-1.14	Yozgat	-2.17
Trabzon	0.65	Rize	-1.15	Kilis	-2.27
Balıkesir	0.62	Burdur	-1.15	Van	-2.32
Aydın	0.49	Erzurum	-1.17	Bingöl	-2.35
Samsun	0.44	Şanlıurfa	-1.2	Kars	-2.44
Sakarya	0.42	Amasya	-1.21	İğdır	-2.64
Manisa	0.31	Bilecik	-1.21	Şırnak	-2.69
Hatay	0.31	Bartın	-1.23	Ağrı	-2.93
Çanakkale	0.19	Çorum	-1.3	Ardahan	-2.94
Yalova	-0.12	Kastamonu	-1.37	Siirt	-2.99
Isparta	-0.14	Kırşehir	-1.39	Bitlis	-3.05
Edirne	-0.31	Ordu	-1.41	Muş	-3.07
Zonguldak	-0.33	Aksaray	-1.48	Hakkari	-3.21

In order to understand the relation between the number of hazardous waste facilities and development index of provinces, first of all, we analyzed the number of incineration, landfill and recycle/recovery facilities of province separately in terms of development index of provinces as shown in Figure 3-27 [45], [47] and we obtained that there may be no relation between the number of hazardous waste incineration and landfill facilities, and development index of provinces because the value of R^2 is too small. However, between the number of hazardous waste

recycle/recovery facilities and development indexes of provinces, there may be relation because although the value of R^2 is not so close to one, it is not small enough to be ignored. Therefore, we can say that the development index of provinces may affect the number of hazardous waste recycle/recovery facilities. In the second place, we analyzed the total number of hazardous waste facilities of provinces with regard to development index of provinces we found that the value of R^2 is 0.6534 and again, it is not small enough to be ignored. As a result of this, there may be relation between the total number of hazardous waste facilities and development indexes of provinces as shown in Figure 3-28 [45], [47]. Therefore, we can say that when the development index of a province increases, the need to have a hazardous waste removal facility can increase and so, the number of hazardous waste facilities should be increased in provinces which have hazardous waste facilities. In addition to this, we can understand that because of low levels of development, hazardous waste facilities have not established in some provinces like Erzurum, Erzincan, Bitlis, Muş, Hakkari, Ağrı, etc. Therefore, we can say that although the development levels of these cities are low, hazardous waste facilities should be established in these cities because in these cities hazardous waste is generated and hazardous waste is an important issue that must be tackled due to their negative effects.

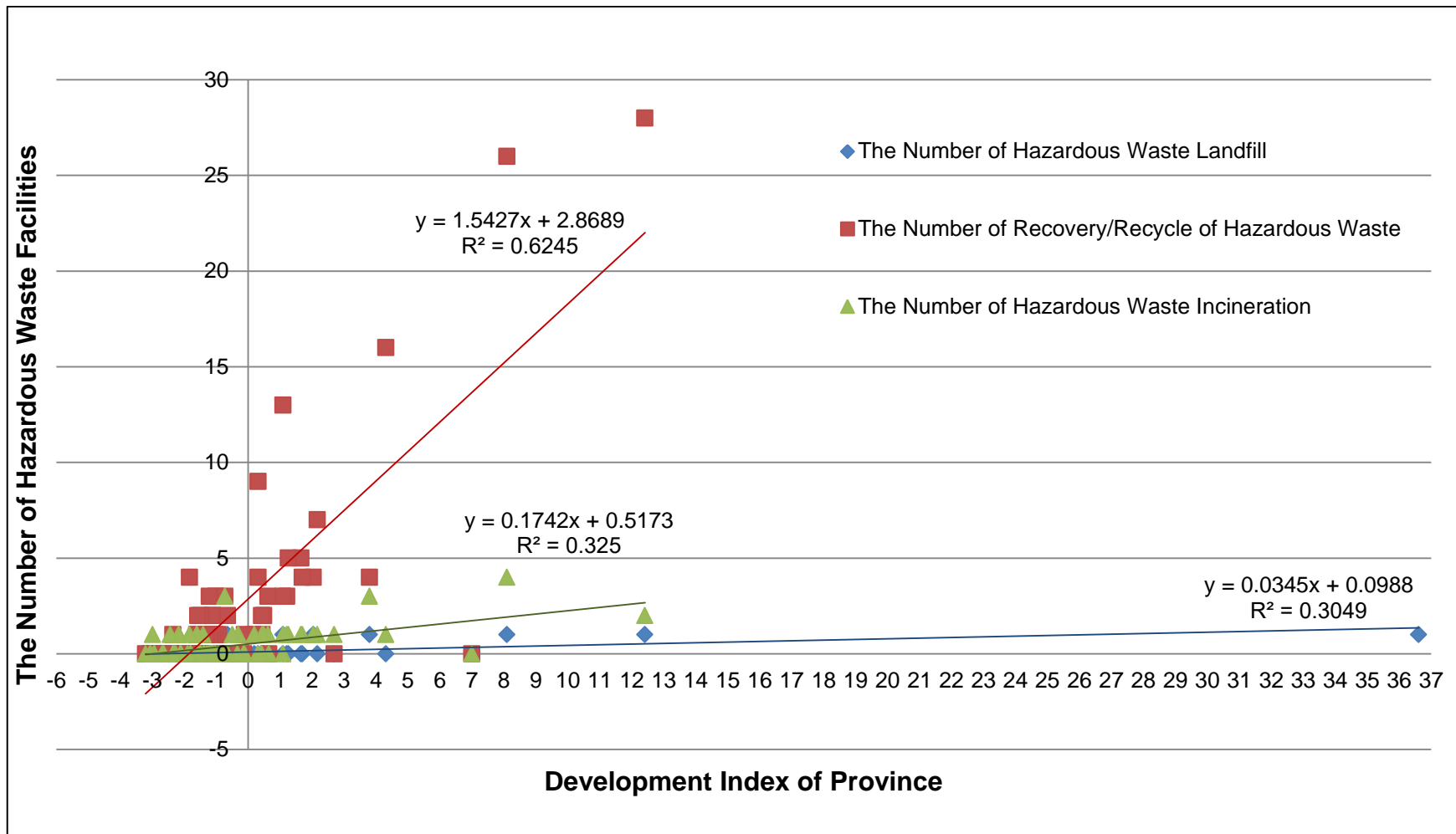


Figure 3-27: The Number of Hazardous Waste Facilities with respect to Development Index of Province in 2015

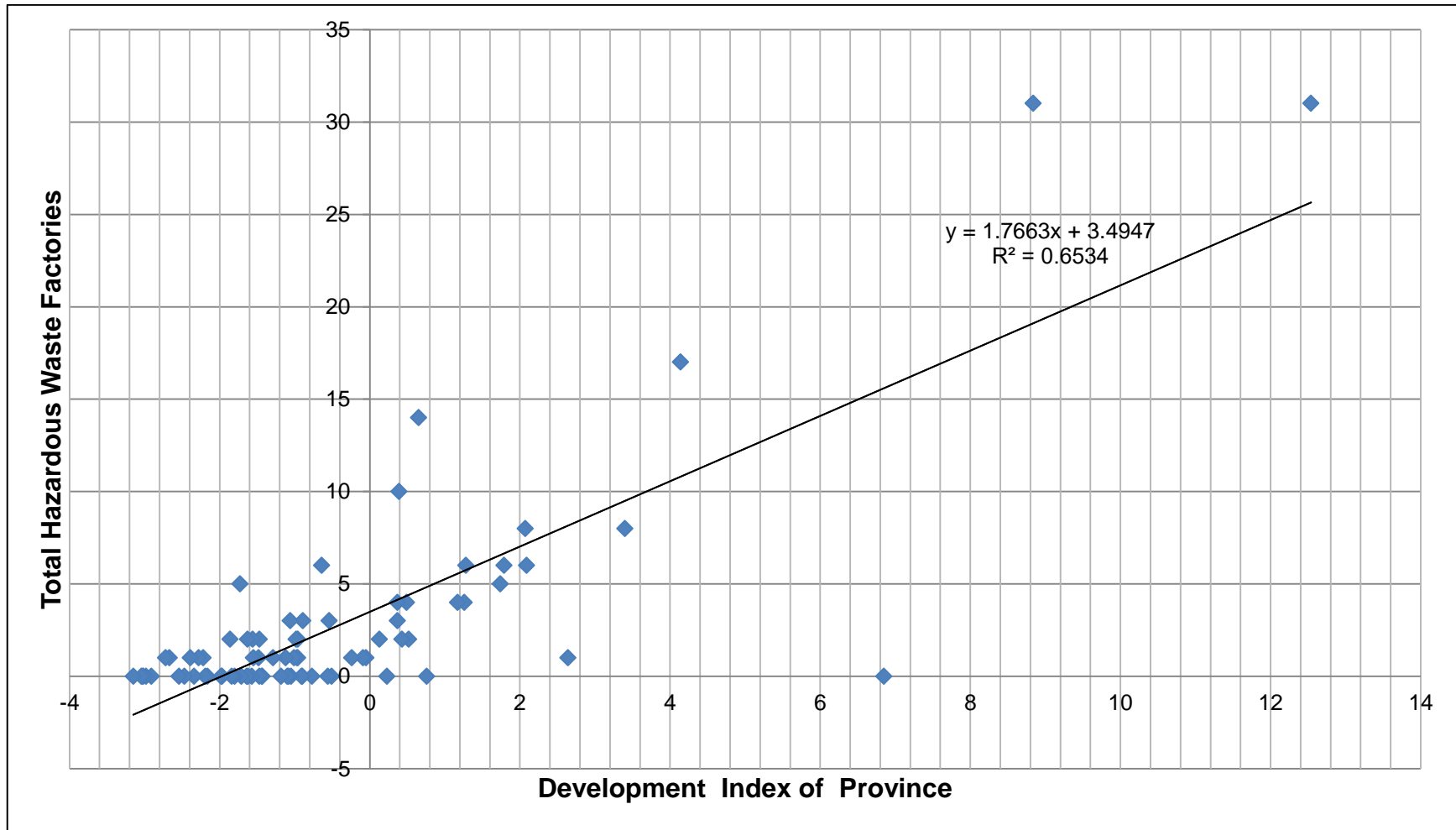


Figure 3-28: The Total Number of Hazardous Waste Facilities with respect to Development Index of Province in 2015

3.3. Hazardous Waste Management Problems

As it is seen from the above sections, hazardous waste management is a crucial issue because it is difficult to create hazardous waste inventory accurately. In addition to this, hazardous waste removal is also very troublesome issue.

When hazardous waste management problems in Turkey are investigated, it is found that there are hazardous waste management problems in terms of administrative and social and in this part, these problems were explained.

3.3.1. Administrative Aspects of Hazardous Waste Management Problems

When the hazardous waste management system of Turkey is investigated, despite progresses since the 90s, still there are a lot of deficiencies in the management systems. The most important deficiency is failure to make an inventory of hazardous waste as it is understood from the above sections. One of the reasons is lack of regular control, which arises due to the lack of staff. Another deficiency is that producers of hazardous waste do not know exactly whether or not their wastes are in hazardous waste class or although they know that, they do not want to declare them as hazardous waste because they do not want to deal with disposal costs [48]. Apart from these, some hazardous waste producers intentionally or unintentionally send their hazardous waste to non-hazardous waste facilities. In addition to these, although the compliance with EU is better in terms of regulations, still there are problems about implementation of regulations. Besides, since the beginning of 2000s, Turkey develops itself in the field of hazardous waste removal and even between 2008 and 2012, Environmental Management Director in Ministry of Environment and Forestry made Waste Action Plan. As a result of this plan, they said that in order to comply with European Union, firstly, the waste should be minimized and prevented at source. If this is not done, secondly, the waste should be reused, recycled and energy is obtained from it. If none of them may not be done, lastly, the waste should be incinerated or landfill. As it understood from Waste Action Plan [49], the incineration and landfill of hazardous waste are undesirable methods because these methods damage environment in the long term. However, still there are facilities which use these removal methods, which means that minimization and prevention of hazardous

waste at source methods are not applied and recycle and recovery facilities are not enough for existing hazardous waste.

3.3.2. Social Aspects of Hazardous Waste Management Problems

When the hazardous waste management system of Turkey is examined, it is understood that there are management problems in terms of social as well as administrative. First of all, it is unknown that whether or not all hazardous waste is treated because the exact amount of hazardous waste produced is not known. As a result of this, if there is a loss between hazardous waste produced and hazardous waste treated, this loss may affect environment and human health. Moreover, incineration and landfill of hazardous waste is still big problem because these processes may cause groundwater pollution, soil pollution and air pollution in long term and so all living creatures are affected negatively from these pollutions. According to World Health Organization, the impact of landfill and incineration as follows;

- Landfills can contaminate drinking water if they are not properly constructed and also, occupational risks exist at disposal facilities if they are not well designed, run or maintained.
- Inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and of ash residue. Incinerated materials containing chlorine can generate dioxins and furans which are human carcinogens and cause adverse effects. Moreover, incineration of heavy metals or materials with high metal content can lead to the spread of toxic metals in the environment [50].

In addition to these, due to all negative effects of landfill and incineration facilities and people's lack of confidence towards the administration, public does not want the establishment of hazardous waste removal plant near places where they live, which is called Not in My Backyard (NIMBY) effect in literature. Therefore, the establishment of hazardous waste removal plant becomes a very big issue.

Consequently, if we summarize administrative and social problems at a table, we obtain Table 3-13 which is shown below.

Table 3-13: Administrative and Social Problems about Hazardous Waste in Turkey

Administrative Problems	Social Problems
Unknowing the exact hazardous waste inventory	Health problems sourced from hazardous waste
Lack of regular control of waste producers	Impacts of landfill and incineration like air pollution, soil pollution, groundwater pollution and drinking water contamination
Lack of control officer or staff	Not in My Backyard Effect
Lack of information of waste producers about hazardous waste	
Ignoring hazardous waste of waste producers due to disposal cost	
Still being used incineration and landfill methods	

3.4. Calculation of the Financial Costs of Hazardous Waste Management Problems

3.4.1. Calculation of the Financial Costs of Administrative Aspects of Hazardous Waste Management Problems

When the hazardous waste management system is investigated, the biggest problem is the creation of hazardous waste inventory. As understood from previous sections, in Turkey, the total amount of hazardous waste generated is not known. Therefore, it is not known whether there is loss in the amount of hazardous waste and if there is loss, it is not known that how much is lost. As a result of these, we will try to assume the total amount of hazardous waste in Turkey by using the data of other countries with high human development index and so, we will calculate the cost of the potential damage of this hazardous waste inventory.

In order to make assumption about hazardous waste inventory, we used the data of Norway, Germany, Belgium, France, Spain, Italy, Greece, Poland, Hungary and Bulgaria, of which the development levels are respectively 1, 6, 21, 22, 26, 27, 29, 36, 44 and 59 [51], and these data are the data of population, GDP, industrial production, municipal waste production and tertiary education which were calculated with low error margin. When we used these data sets, we examined their effects on the amount of hazardous waste and in order to determine their effects, we tried all relation types and finally, we created linear charts and also polynomial charts. In addition to these, when we made this assumption, we accepted that there are effects of data sets of which R^2 values are between 0.75 and 1.

Firstly, we created charts for population data and we obtained Figure 3-29 [1], and we saw that the R^2 values of chart is not bigger than 0.75. Therefore, we created charts again by excluding the data set of Bulgaria because these data are far from the distribution of other data sets and so, we obtained Figure 3-30 [1]. As a result of this, we found that although the R^2 value of linear chart is not higher than 0.75, the R^2 value of polynomial chart is higher than 0.75 and also it is close to 1. Therefore, we can say that there is polynomial effect of population on hazardous waste production.

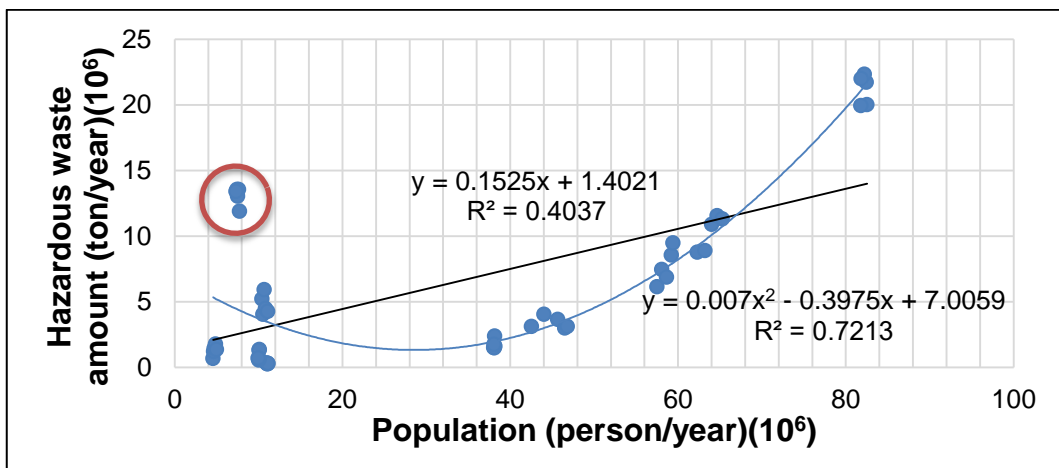


Figure 3-29: Hazardous waste and Population relation for European countries

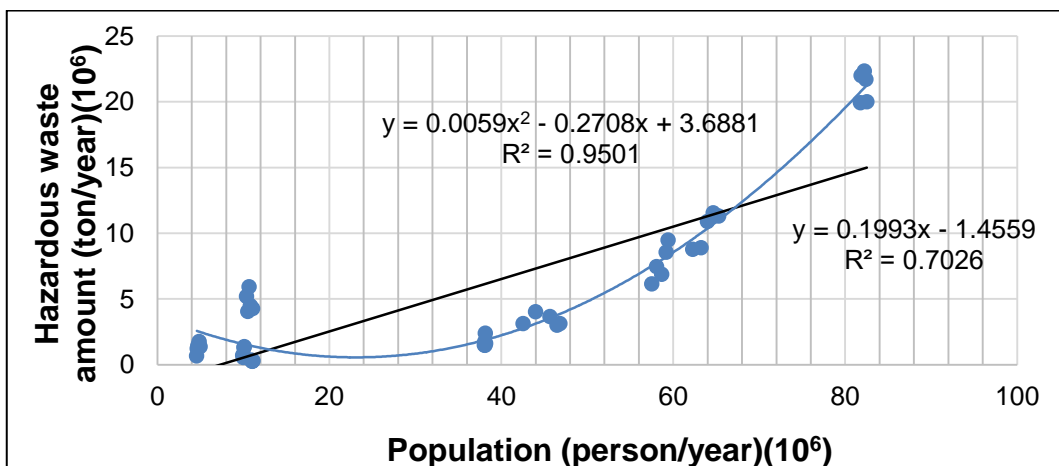


Figure 3-30: Hazardous waste and Population relation for European countries
(Excluding the data set of Bulgaria)

Secondly, we created charts for GDP data set and we obtained Figure 3-31 [1], [38], and we found that R^2 values of these charts are not higher than 0.75, which

means that there is no exact relation between hazardous waste and GDP. Therefore, we created charts again by excluding the data set of Bulgaria because the data set is far from the distribution of other data sets and so we found that the R^2 values is bigger than 0.75 as shown in Figure 3-32 [1], [38]. However, the R^2 value of polynomial chart is closer to 1 than the R^2 value of linear chart. As a result of this, we can say that while making assumption about hazardous waste inventory, we can use polynomial effect of GDP on hazardous waste production.

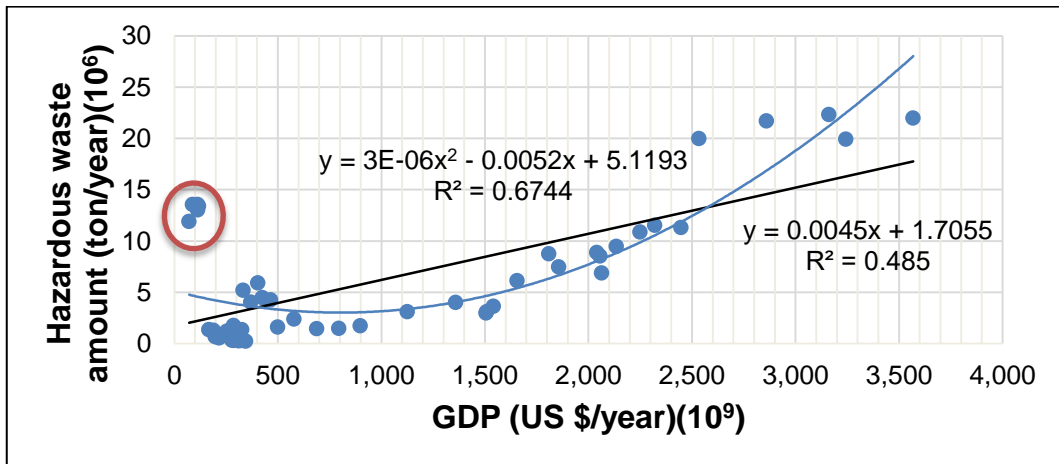


Figure 3-31: Hazardous waste and GDP relation for European countries

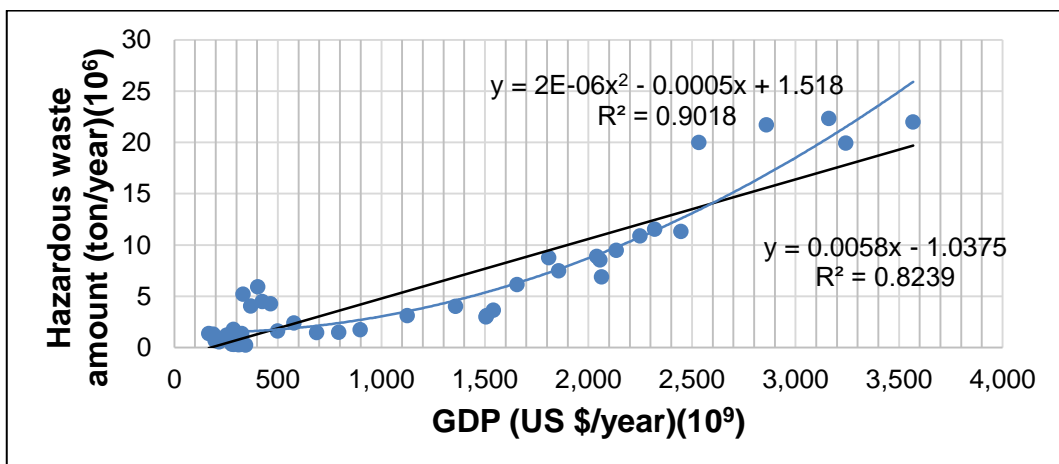


Figure 3-32: Hazardous waste and GDP relation for European countries (excluding the data set of Bulgaria)

Thirdly, we created charts for Industrial production data set and we obtained Figure 3-33 [1], [40]. As understood from this graph, the R^2 values of these charts are smaller than 0.75, which means that there may be less effect of industrial production on hazardous waste. For this reason, we created charts again by

excluding the data set of Bulgaria due to the dispersed compared to the data sets of other countries and we saw that the R^2 values of these charts is higher than 0.75 as shown in Figure 3-34 [1], [40]. However, we can use polynomial effect of industrial production to estimate while estimating hazardous waste production because the R^2 value of polynomial chart is bigger than the R^2 value of linear chart, which means that it gives a more accurate value about hazardous waste production.

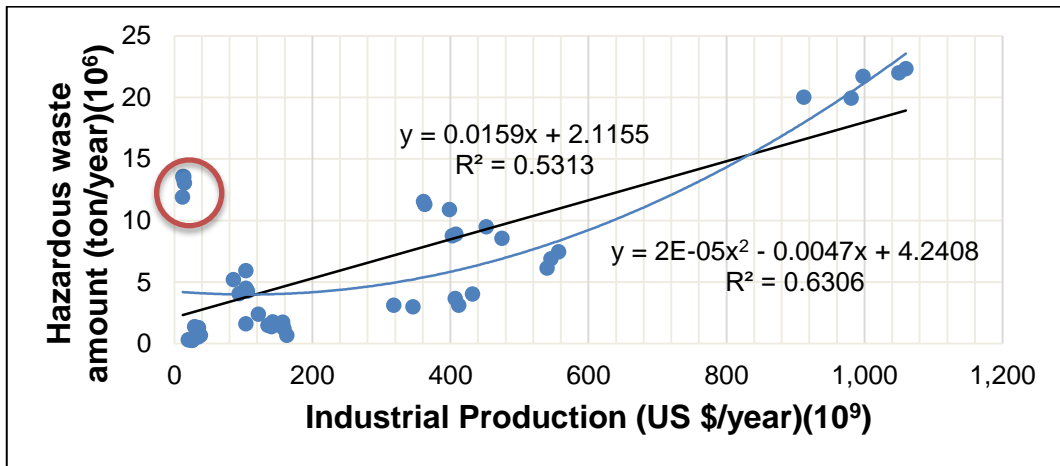


Figure 3-33: Hazardous waste and Industrial production relation for European countries

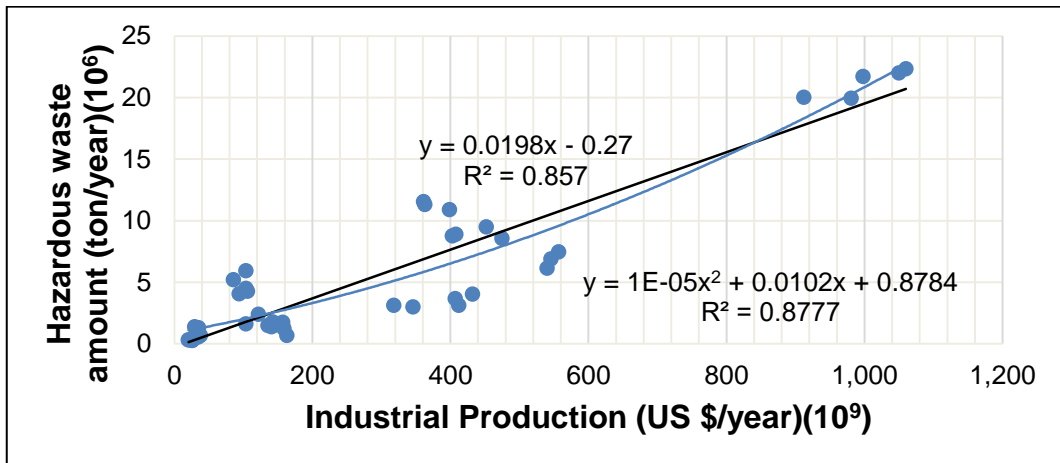


Figure 3-34: Hazardous waste and Industrial production relation for European countries (excluding the data set of Bulgaria)

Fourthly, we created charts for municipal waste data set and we obtained Figure 3-35 [1]. As understood from the Figure 3-36 [1], the R^2 values of these charts are smaller than 0.75 because the data set of Bulgaria prevents us to obtain accurate

graphics. Therefore, we created charts again by excluding these values and we found that the R^2 values of new charts are greater than 0.75 as shown in Figure 3-36 [1]. However, we can say that polynomial effect of municipal waste production is much more than linear effect because its R^2 value of polynomial chart is closer to 1 than linear chart's, which means that it gives more accurate values about hazardous waste production.

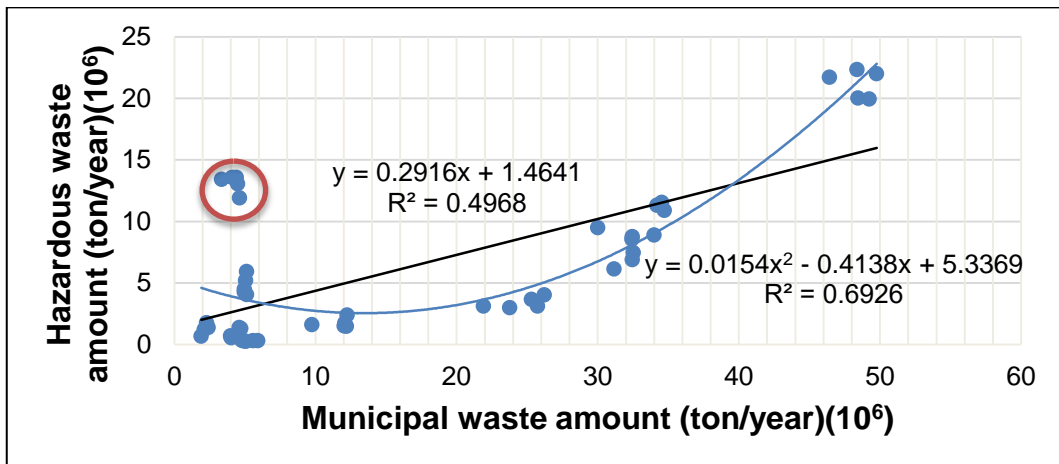


Figure 3-35: Hazardous waste and Municipal waste relation for European countries

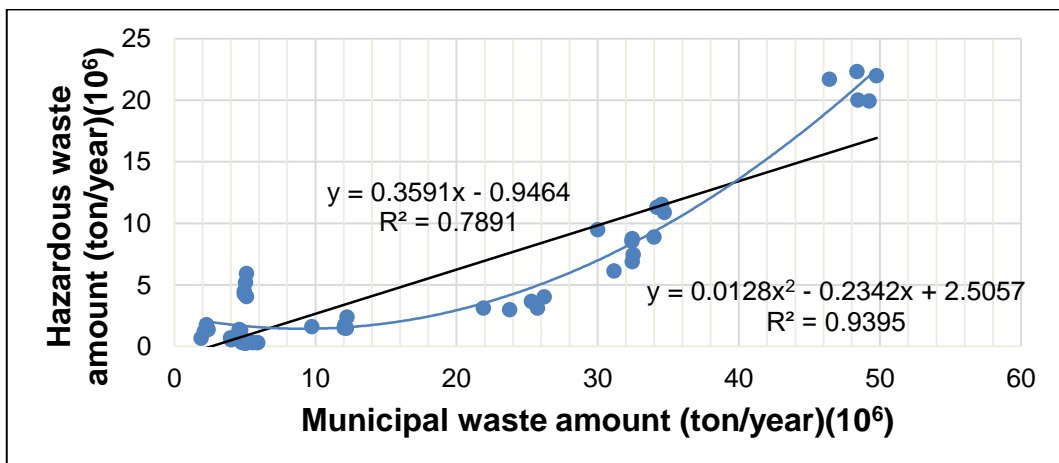


Figure 3-36: Hazardous waste and Municipal waste relation for European countries (excluding the data set of Bulgaria)

Lastly, we created charts for the number of tertiary educated people, which is proportioned with population, and we obtained Figure 3-37 [1]. As understood from the figure, although the R^2 value of polynomial chart is close to 0.75, it is not enough to use it for estimation. Besides, the R^2 value of linear chart is smaller than

0.75. In addition to these, the all data set is around charts, which means that it is not necessary to create charts again. As a result, we can say that there is no high level effect of the tertiary educated people on hazardous waste production.

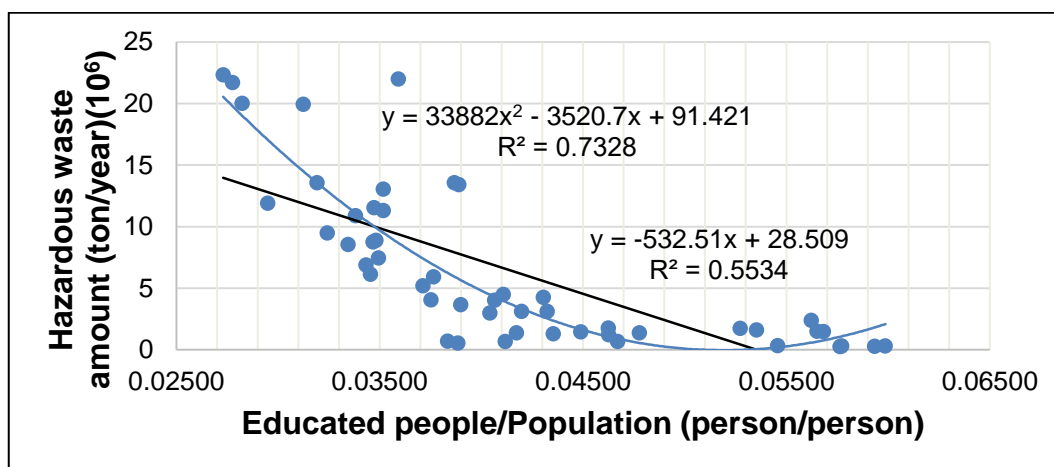


Figure 3-37: Hazardous waste and Tertiary Educated people/Population relation for European countries

Consequently, it is understood from the graphs, the hazardous waste production is affected by GDP, industrial production and municipal waste production linearly. However, the polynomial effect of these factors on hazardous waste production is much more than the linear ones. Also, there is polynomial effect of population on hazardous waste production and the effect of this factor is much more than the others, which is shown in Table 3-14, because the R^2 value of the equation of this factor is so close to 1.

Table 3-14: Linear and polynomial equations according to all factors

Factors	Linear Equation	R^2 value of equation
Population	$y = 0.1993x - 1.4559$	$R^2 = 0.7026$
GDP	$y = 0.0058x - 1.0375$	$R^2 = 0.8239$
Industrial Production	$y = 0.0198x - 0.27$	$R^2 = 0.857$
Municipal Waste Production	$y = 0.3591x - 946390$	$R^2 = 0.7891$
Tertiary Education	$y = -532.51x + 28.509$	$R^2 = 0.5534$
Factors	Polynomial Equation	R^2 value of equation
Population	$y = 0.0059x^2 - 0.2708x + 3.6881$	$R^2 = 0.9501$
GDP	$y = 2E-06x^2 - 0.0005x + 1.518$	$R^2 = 0.9018$
Industrial Production	$y = 1E-05x^2 + 0.0102x + 0.8784$	$R^2 = 0.8777$
Municipal Waste Production	$y = 0.0128x^2 - 0.2342x + 2.5057$	$R^2 = 0.9395$
Tertiary Education	$y = 33882x^2 - 3520.7x + 91.421$	$R^2 = 0.7328$

After the effects of these factors were determined, we tried to create an equation by using all factors and in order to do that, we used Statgraphics programmer. In this programmer, we used linear multiple regression analysis to obtain an equation with all factors and we took hazardous waste as dependent variable and population, GDP, industrial production, municipal production and the number of tertiary educated people as independent variable, which are shown in Table 3-15. As a result of linear multiple regressions in Statgraphics programmer, we obtained Equation 3-1, which is shown below. According to this equation, only industrial production and GDP affects hazardous waste production, and the R^2 value of this equation is 0.87. Although this value is very close to 1, it is known that except the number of tertiary educated people, there are polynomial effects of all factors on hazardous waste production. Besides, it is known that population factor has high level effect on hazardous waste production, which is not in Equation 3-1. For this reason, by taking the squares of these values and adding these values to multiple regression data sets, a new equation was created in Statgraphics programmer, as shown in Equation 3-2. Also, it was found that the R^2 value of this new equation is 0.97. As a result of this, it was determined that Equation 3-2 is more proper for estimation of hazardous waste inventory.

$$\text{Hazardous waste production} = -749,985 + 0.0000130084 * \text{Industrial production} + 0.0000021789 * \text{GDP} \quad \text{Equation 3-1}$$

$$\text{Hazardous waste production} = 2.7422 * (10^7) + 1.35553 * (10^{-9}) * \text{Population}^2 + 0.00000350348 * \text{GDP} - 0.505365 * \text{Municipal waste production} + 8.00115 * (10^{-9}) * \text{Municipal waste production}^2 - 9.56769 * (10^8) * \text{Tertiary education} + 8.86624 * (10^9) * \text{Tertiary education}^2 \quad \text{Equation 3-2}$$

By using Equation 3-2, we calculated hazardous waste production from 2009 to 2015 in order to evaluate current hazardous waste system and we found that from 2009 to 2015, 8,345,298 tons of hazardous waste should have been produced. When this amount was calculated the amount of known hazardous waste was subtracted from the total calculated hazardous waste amount. Also, uncounted amount, which was obtained from the difference between the amount of hazardous waste produced and treated (which is shown in Table 3-10) in 2014, was subtracted from the total calculated hazardous waste amount and this value

was considered as fixed for these years, as shown in Table 3-16. Consequently, we assumed that 8,345,939 tons of hazardous waste has been dumped.

Table 3-15: The data of factors for multiple regressions

Year	Population (person/year)	GDP (US \$/year)	Industrial Production (US \$/year)	Municipal Waste Production (ton/year)	The ratio of tertiary educated people number/Population (person/person)
2009	72,561,312	1,044,056,200,000	110,541,716,967	24,548,753*	0.0403*
2010	73,722,988	1,168,956,700,000	139,840,776,212	25,277,000	0.0479
2011	74,724,269	1,308,343,100,000	192,614,591,804	25,898,378*	0.0511
2013	76,667,864	1,451,518,000,000	233,749,386,661	27,794,959*	0.0649
2014	77,695,904	1,502,524,800,000	278,584,395,845	28,011,000	0.0704
2015	78,741,053	1,542,572,890,900	298,921,836,205	27,724,989*	0.0622*

(These values were calculated by using linear equations which were created from other datas of thses factors.)

Table 3-16: The difference between Known Hazardous waste and Calculated Hazardous Waste Amount with respect to the Equation of Multiple Regression

Year	Hazardous Waste Amount (Calculated) (ton/year)	Known Hazardous Waste amount (ton/year)	Uncounted Amount (ton/year)	Difference (ton/year)
2009	6,474,414	629,029	4,846,497	998,888
2010	5,736,421	786,418	4,846,497	103,506
2011	6,113,813	938,498	4,846,497	328,818
2013	7,860,268	1,373,384	4,846,497	1,640,387
2014	9,576,949	1,413,220	4,846,497	3,317,232
2015	8,160,944	1,357,340	4,846,497	1,957,107
Total	43,922,810	6,497,889	29,078,982	8,345,939

According to this assumption, we tried to make a general cost calculation for the removal actions of this amount and we calculated the cost of landfill, incineration and recycling to remove this amount from the environment.

For the landfill cost of all dumped hazardous waste, we took fee as 260 TL per ton according to personal communication with İZAYDAŞ in 2017.

The total cost for landfill= (8,345,939 ton) *(260 TL /ton) = 2,169,944,140 TL

For the incineration cost of all dumped hazardous waste, we took fee 500 TL per ton as minimum and 3,000 TL per ton as maximum according to personal communication with İZAYDAŞ in 2017.

The min. total cost for incineration= (8,345,939 ton) *(500 TL/ton) =
= 4,172,969,500 TL

The max. total cost for incineration= (8,345,939 ton) *(3,000 TL/ton) =
= 25,037,817,000 TL

For the recycling cost of all dumped hazardous waste, we took fee as 147 Dollars per ton [52].

The total cost for recycling = (8,345,939 ton) *(147 Dollars/ton) =
= 1,226,853,033 Dollars

Consequently, according to our calculation, existing hazardous waste amount is lesser than calculated hazardous waste amount, which means that there are deficiencies in the current system.

3.4.2. Calculation of the Financial Costs of Social Aspects of Hazardous Waste Management Problems

When social aspects of hazardous waste management problems are examined, one of the most important problems is the effect of dumped hazardous waste on people's health and environment. Although we can make assumption about the amount of hazardous waste which is dumped and the removal cost of this dumped hazardous waste, we can not make assumption about the cost of their effects on people's health and environment because in order to calculate this, we must know the types of hazardous waste and the dumping sites of these hazardous waste. Therefore, in this section, we tried to calculate the cost of the effects of landfill and incineration methods if this dumped hazardous waste is buried or incinerated. Any calculation was not made for recycling because no cost was found for this method.

As understood from Table 3-17, environmental cost estimates for landfill and incineration are 26.35 and 45.95 Euro.

Table 3-17: Environmental cost estimates for landfilling and incineration [53]

Cost (Euro per ton)	Landfilling	Incineration
Emissions to air	5.84	17.26
Emissions to water	0.0	0.0
Chemical waste	2.63	28.69
Land use	17.88	0.00
Total	26.35	45.95

If all dumped hazardous waste is buried, environmental cost will be 219,915,493 Euros as you can see below.

$$\begin{aligned} \text{Environmental cost for landfill} &= (26.35 \text{ Euro/ton}) * (8,345,939 \text{ ton}) = \\ &= 219,915,493 \text{ Euros} \end{aligned}$$

If all dumped hazardous waste is incinerated, environmental cost will be 383,495,897 Euros as you can see below.

$$\begin{aligned} \text{Environmental cost for incineration} &= (45.95 \text{ Euro/ton}) * (8,345,939 \text{ ton}) = \\ &= 383,495,897 \text{ Euros} \end{aligned}$$

Unfortunately, although we knew the possible health effects of landfill and incineration of hazardous waste, which is mentioned in 3.3.2 Section, we did not calculate the cost of these effects because we did not find any cost estimation about this subject.

Apart from these, we tried to find solution about NIMBY problem. In order to do that, we examined investment cost for construction of landfill and incineration and also, we examined the transportation and removal cost of hazardous waste. Unfortunately, we did not find general investment cost for construction of recycling because recycling facilities are constructed for the type of waste.

Although we did not find exact investment cost for construction of a landfill, we found the investment cost of a hazardous waste landfill in Tunisia as an example. Therefore, we have an idea about investment cost of a landfill at least. As understood from the total cost investment in Tunisia in 2003, the total cost investment for landfill construction is 7.5 million Euros and this cost may be much more today.

Cost of hazardous waste landfill in Tunisia in 2003 [54]:

The amount of waste which is buried: 25,000 ton/year

Total waste capacity (Operating time: 20 years): 500,000 ton

The total volume of waste: 335,000 m³

Total landfill area: 33,000 m²

Surface area of leachate evaporation pool: 5,000 m²

The cost of final surface closure and greening: 2.5 million Euros

The total investment cost: 5 million Euros

Total cost: 7.5 million Euros

According to Technology and Site Selection Technical Feasibility Report for Solid Waste Incineration Plants, investment costs for solid waste incineration plants are given in Table 3-18. As understood from the table, for the incineration plant of which capacity is 240 ton/day, investment cost is between 316-373 million TL.

Table 3-18: Investment costs for solid waste incineration plants (million TL) [55]

Unit	Hazardous waste incineration plant
Capacity	10 ton/hour (240 ton/day)
Building and infrastructure construction	70-85
Incineration and energy recovery units	70-80
Stack gas, wastewater and solid waste treatment/operation	80-90
Intermediate storage for hazardous waste	30-40
Electro technical equipment	30-35
Power transmission technology	30-35
Auxiliary facilities	6-8
Total	316-373

Although we contact to a lot of facilities which remove or transport hazardous waste, we did not took exact removal cost, except İZAYDAŞ, and transport cost for hazardous waste. Therefore, we did not calculate total cost for removal and transport cost for hazardous waste. However, with respect to personal communication with facilities, it was determined that for the removal cost, they pay attention to chlorine content and moisture content and also, colorimetric properties of hazardous waste. Also, for the transportation cost, they pay attention to distance, fuel money, depreciation and also, degree of dangerousness of

hazardous waste. At the end of these, they calculate removal and transportation costs. Consequently, by comparing these situations, the best choice can be made about whether or not a hazardous waste removal facility is constructed in a city.

4. CONCLUSION

The following results were obtained according to the studies carried out in the thesis.

- Most of the hazardous waste was generated at the field of metal manufacturing.
- Although, there are effects of all factors, except tertiary education, on hazardous waste production with respect to all European data sets, there is no effect of population, industrial production and municipal waste on hazardous waste production according to the data sets of Turkey.
- According to information in 2015, there are 201 facilities which recycle hazardous waste, 36 facilities which incinerate hazardous waste and 8 facilities which have hazardous waste landfill. When the distribution of these plants in Turkey was examined, it is noticed that the number decreases from west to east.
- Most of the license for hazardous waste is about recycling (29 %) in 2015.
- The development indexes of provinces may affect the number of hazardous waste recycling facilities and the total number of hazardous waste removal facilities.
- When the current hazardous waste system was examined, it was found that there are deficiencies about calculation of hazardous waste inventory and also, 8,345,939 ton should have been produced in addition to known hazardous waste amount from 2009 to 2015 according to our calculations.
- For the removal cost of 8,345,939 tons of hazardous waste, the following quantities were determined.
 - ✓ The total cost for landfill = 2,169,944,140 TL
 - ✓ The min. total cost for incineration = 4,172,969,500 TL
The max. total cost for incineration = 25,037,817,000 TL
 - ✓ The total cost for recycling = 1,226,853,033 Dollars
- For the environmental cost of 8,345,939 tons of hazardous waste, the following quantities were determined.
 - ✓ Environmental cost for landfill of all amount = 219,915,493 Euros
 - ✓ Environmental cost for incineration of all amount = 383,495,897 Euros

- For investment of construction of landfill and incineration plants, the following costs were determined.
 - ✓ Investment cost for landfill construction = Approximately 7.5 million Euros
 - ✓ Investment cost for incineration construction= 316-373 million TL.

5. RECOMMENDATIONS FOR FUTURE STUDIES

Based on the results of this study, the following recommendations should be considered to fill the scientific gap for hazardous waste management in Turkey.

Generally,

- Hazardous waste education should be given to the public and people working in this area for the awareness.
- The exact amount of hazardous waste should be known.
- Waste producers should be controlled regularly and so, more officers/staff should be employed.
- How much waste is incinerated, buried and recycled should be known.
- All hazardous waste should be recycled and reused if it is possible.
- Incineration and landfill of hazardous waste should not be used if it is possible but if it is not possible, necessary precautions should be taken for the negative effects of incineration and landfill on people's health and environment.

Specifically,

- Models should be developed in order to calculate hazardous waste amount.
- Social effects of hazardous waste production should be investigated in detail and studies should be done in this field.
- Removal methods should be found and developed for manufacturing of metals.

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APPENDIXES

Appendix-A: Data Evaluation of European Countries

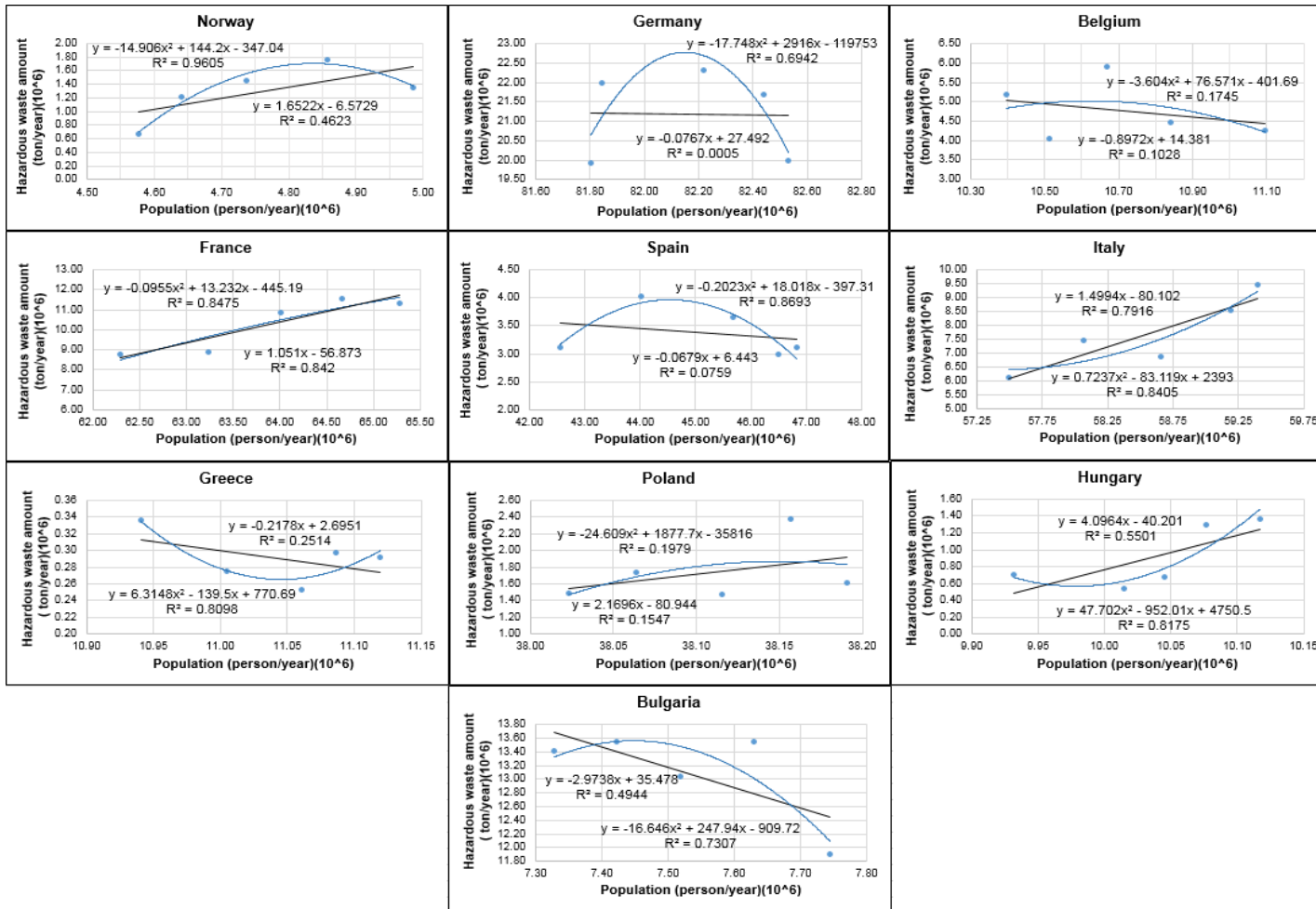


Figure A-1: The impact of population on hazardous waste amount in European countries [1]

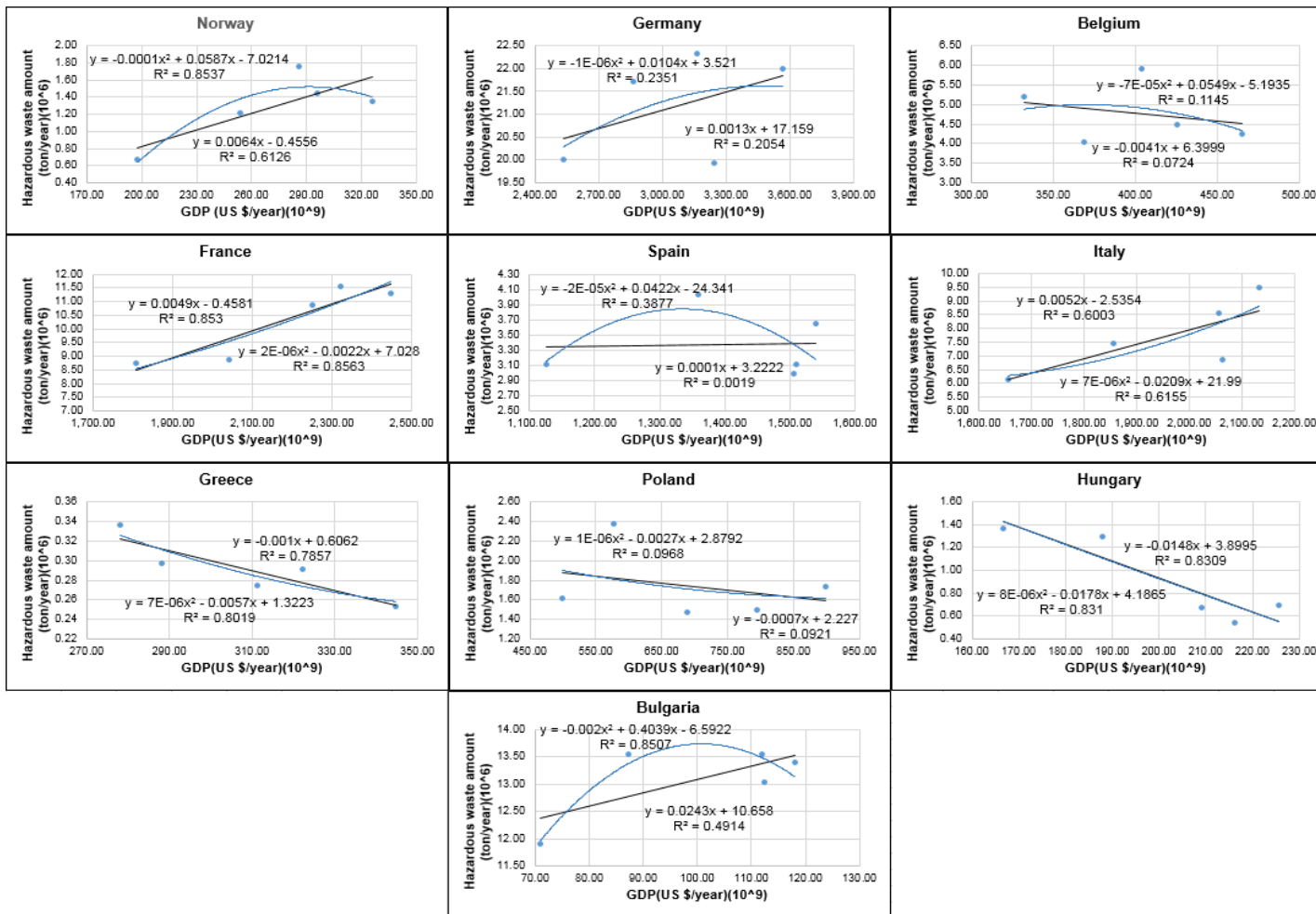


Figure A-2: The impact of GDP on hazardous waste amount in European countries [1], [38]

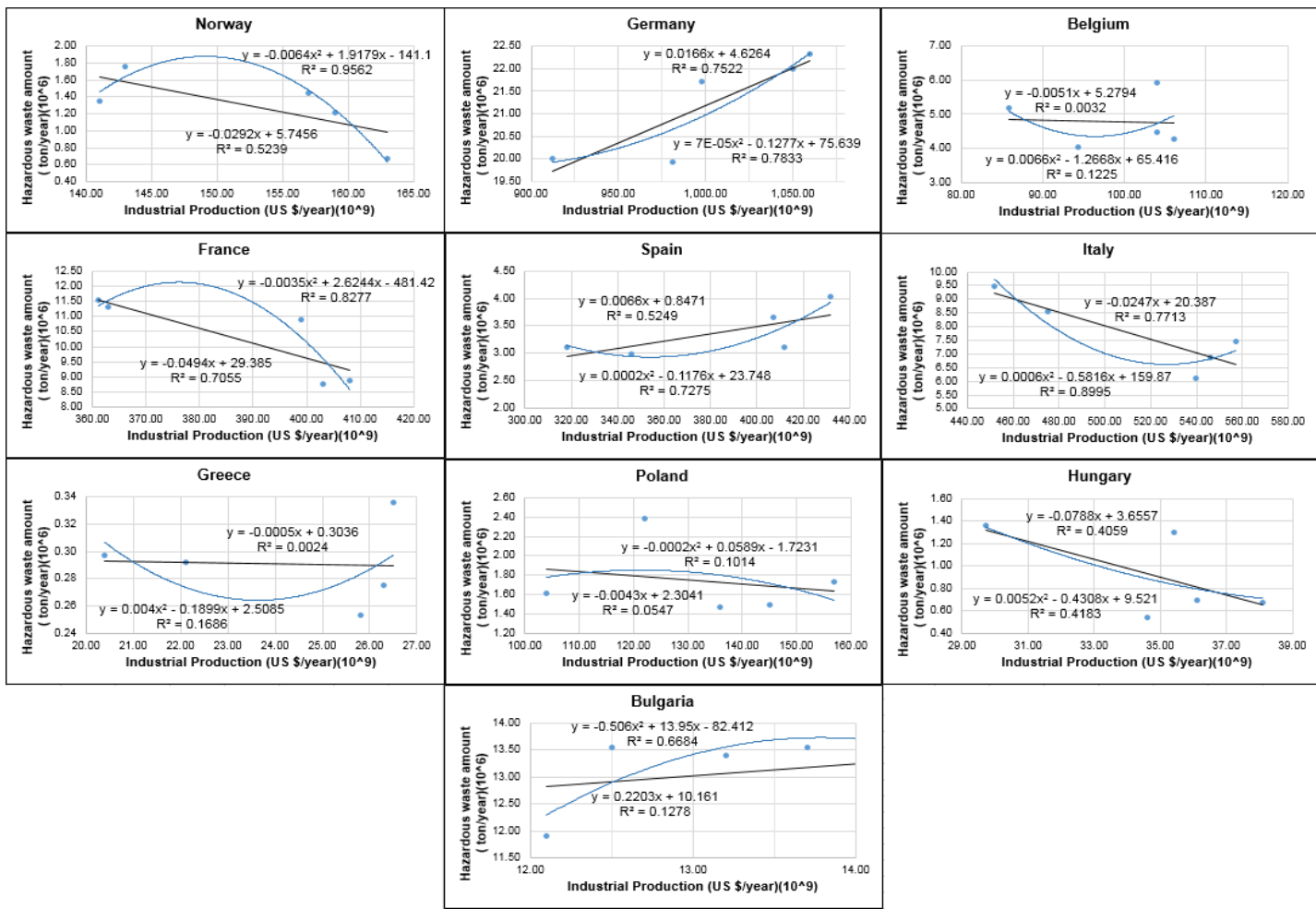


Figure A-3: The impact of Industrial production on hazardous waste amount in European countries [1], [40]

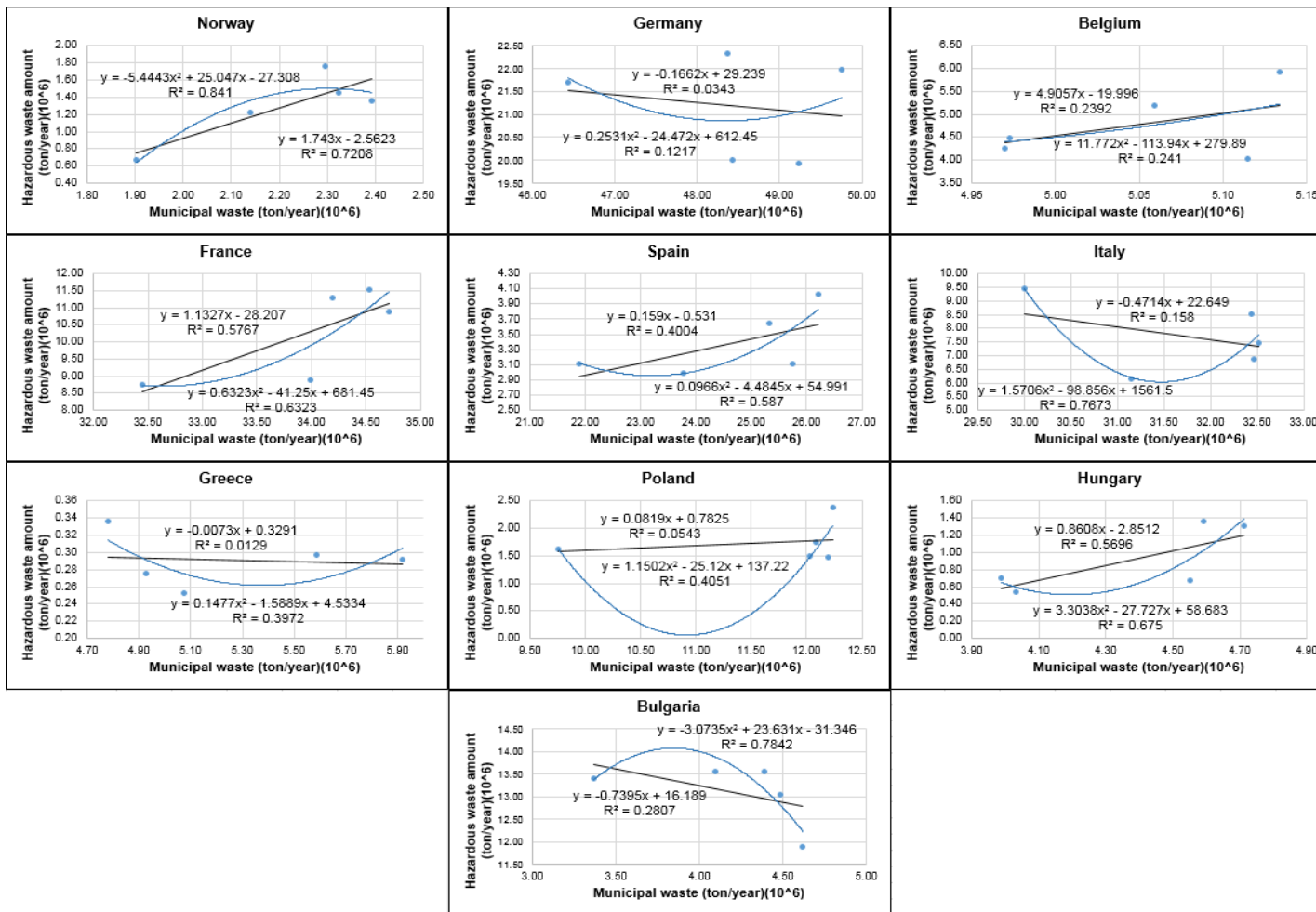


Figure A-4: The impact of Municipal waste amount on hazardous waste amount in European countries [1]

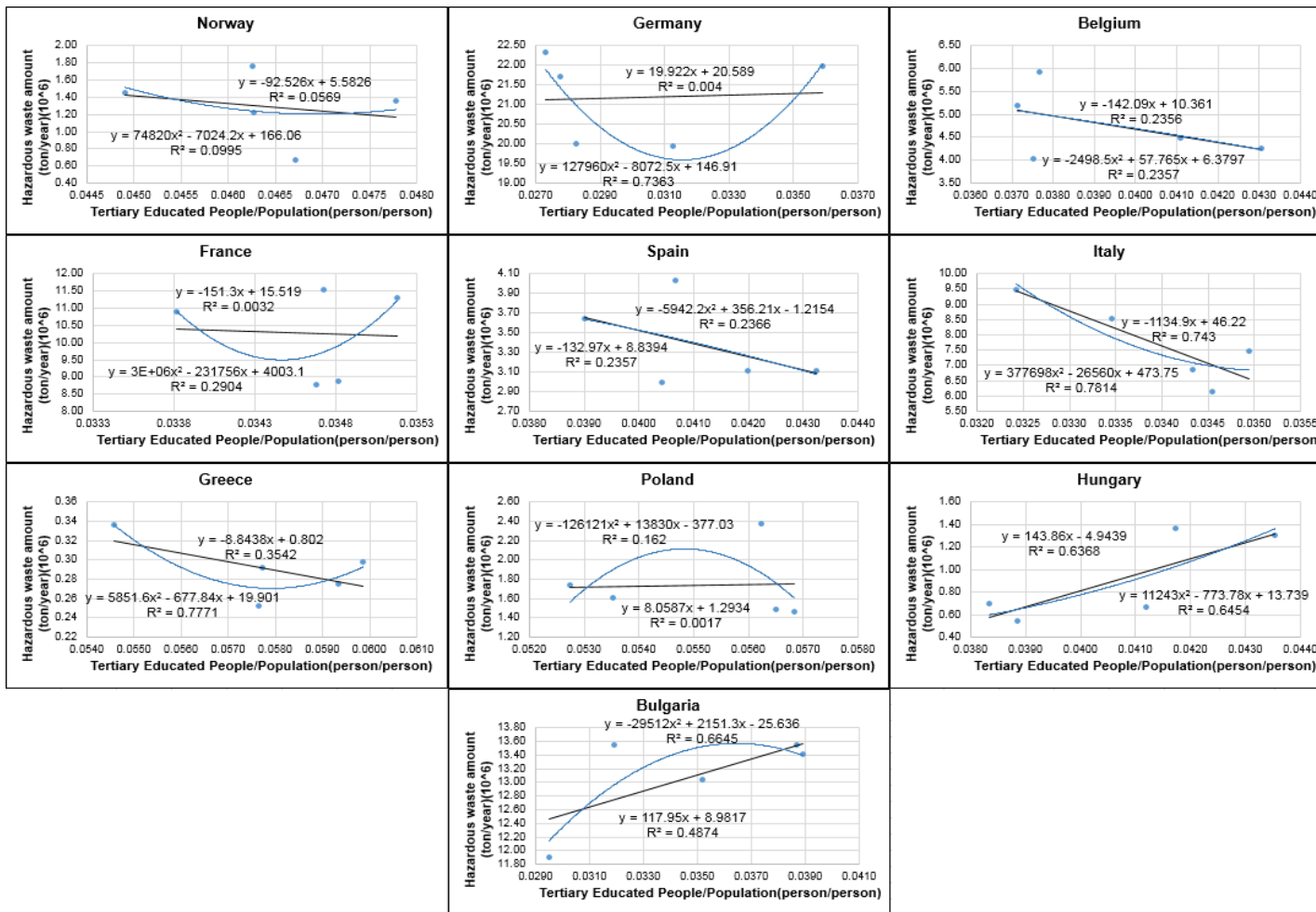


Figure A-5: The impact of ratio of Tertiary educated people/Population on hazardous waste amount in European countries [1]

Appendix-B: Names and Permit License Issues of Hazardous Waste Removal Facilities

Table B-1: Names and Permit License Issues of Hazardous Waste Removal Facilities in 2015 [45]

INCINERATION

Firm Name	Permit License Issues
Adana Çimento Sanayi Türk A. Ş.	Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Çimko Çimento ve Beton. San. Tic. A.Ş. Adıyaman Şubesi	Air Emission, Wastewater Discharge, Incineration and Co-incineration
Limak Batı Çimento Sanayi ve Ticaret Anonim Şirketi Ankara Şubesi	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Baştaş-Başkent Çimento Sanayi ve Tic. A. Ş.	Air Emission, Waste Incineration and Co-incineration, Non-hazardous Waste Recycling
Batisöke Söke Çimento Sanayii Türk A. Ş.	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Limak Batı Çimento ve San. ve Tic. A. Ş. Balıkesir Şubesi	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Bolu Çimento Sanayii A. Ş.	Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Bursa Çimento Fabrikası A. Ş.	Air Emission, Waste Incineration and Co-incineration, Non-hazardous Waste Recycling
Akçansa Çimento Sanayi ve Ticaret A.Ş. Çanakkale Şubesi Çimento Fabrikası	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Denizli Çimento Sanayi Türk Anonim Şirketi	Air Emission, Wastewater Discharge, Waste Incineration and Co-incineration
Çimentaş İzmir Çimento Fabrikası Türk A. Ş. Trakya Şubesi	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Çimsa Çimento San. Tic. A.Ş. Eskişehir Çimento Fabrikası Şubesi	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Limak Çimento San. ve Tic. A. Ş. Gaziantep Şubesi	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Çimsa Çimento San. ve Tic. A. Ş. Mersin Çimento Fabrikası Şubesi	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Akçansa Çimento Sanayi ve Tic. A. Ş. Büyükçekmece Fabrika	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration

Firm Name	Permit License Issues
Batiçim Batı Anadolu Çimento Sanayii A. Ş.	Air Emission, Noise Control, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
İzmir Çimento Fabrikası Türk A. Ş. Çimentaş	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Osman Sönmez İnş. Taah Tic.	Air Emission, Wastewater Discharge, Waste Incineration and Co-incineration
Petkim Petrokimya Holding A. Ş.	Wastewater Discharge, Air Emission, Waste Incineration and Co-incineration, Waste Receiving Facility
Kars Çimento San. ve Tic. A. Ş.	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Çimsa Çimento San. ve Tic. A. Ş. Kayseri Çimento Fabrikası Şubesi	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Kimtaş Kireç San. ve Tic. A. Ş. Pınarhisar Şubesi	Air Emission, Waste Incineration and Co-incineration
Limak Batı Çimento Sanayi ve Ticaret Anonim Şirketi Trakya Şubesi	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Traçim Çimento Sanayi Ticaret A. Ş. Vize Şubesi	Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
İzaydaş İzmit Atık ve Art. Arıtma Yak. ve Değer A. Ş.	Air Emission, Waste Incineration and Co-incineration, Landfill- First Class (Hazardous Waste Landfill)
Aslan Çimento Anonim Şirketi	Noise Control, Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration, Waste Receiving Facility
Nuh Çimento Sanayi A. Ş. Hereke Şubesi	Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Konya Çimento Sanayi A. Ş.	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Mardin Çimento Sanayii ve Ticaret A. Ş.	Air Emission, Wastewater Discharge, Waste Incineration and Co-incineration
Muğla Kireç Sanayi A. Ş.	Air Emission, Waste Incineration and Co-incineration
Çimsa Çimento San. ve Tic. A. Ş. Niğde Şubesi	Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Ünye Çimento San ve Tic. A. Ş.	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Akçansa Çimento Sanayi ve Tic. A. Ş. Samsun Ladik Şubesi	Air Emission, Wastewater Discharge, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration

Firm Name	Permit License Issues
Limak Çimento Sanayi ve Ticaret Anonim Şirketi	Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Adoçim Çimento Beton San. ve Tic. A. Ş. Artova Şubesi	Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration
Yibitaş Yozgat İşçi Birliği İnş. Malz. Tic. Ve San. A. Ş.	Wastewater Discharge, Air Emission, Non-hazardous Waste Recycling, Waste Incineration and Co-incineration

LANDFILL

Firm Name	Allowance License Issues
İskenderun Enerji Üretim ve Ticaret A. Ş.	Deep Sea Discharging, Air Emission, Landfill- First Class (Hazardous Waste Landfill), Landfill- Second Class (Municipal Waste and Non-hazardous Waste Landfill), Waste Receiving Facility
ITC Invest Trading & Consulting AG- Türkiye Ankara Şubesi	Landfill- First Class (Hazardous Waste Landfill), Waste Interim Storage
İSTAÇ İstanbul Çevre Yönetimi Sanayi ve Ticaret Anonim Şirketi- Kömürcüoda Tesisleri	Wastewater Discharge, Landfill- First Class (Hazardous Waste Landfill), Waste Interim Storage
İZBAŞ İzmir Serbest Bölge Kurucu ve İşleticisi Anonim Şirketi	Wastewater Discharge, Landfill- First Class (Hazardous Waste Landfill)
İzaydaş İzmit Atık ve Art. Arıtma Yak. ve Değer A. Ş.	Air Emission, Waste Incineration and Co-incineration, Landfill- First Class (Hazardous Waste Landfill)
Eti Gümüş Anonim Şirketi Kütahya Şubesi	Wastewater Discharge, Air Emission, Hazardous Waste Recycling, Landfill- First Class (Hazardous Waste Landfill)
Süreko Atık Yönetimi Nakliye Lojistik Elektrik Üretim A. Ş. Kule Şubesi	Wastewater Discharge, Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Landfill- First Class (Hazardous Waste Landfill), Waste Interim Storage, Packaging Waste Collection and Separation
Ekolojik Enerji A. Ş. Çorlu Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Landfill- First Class (Hazardous Waste Landfill), Waste Interim Storage, Packaging Waste Collection and Separation

HAZARDOUS WASTE RECYCLING

Firm Name	Allowance License Issues
Erler Boya Tiner Madeni Yağ İmalat Geri Dönüşüm Hırdavat Nak. Kimya San. Tic. Paz. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Mahmut Erdoğan	Air Emission, Hazardous Waste Recycling
Meltem Kimya ve Tekstil Sanayi İth. İhr. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
RDF Kontamine Atık Bertaraf ve Geri Kaz. San. Ltd. Şti. Adana Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
E. C. C. Kimya Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Wastewater Discharge
Şabaplı Metal Geri Kazanım San. Tic. Ltd. Şti. Geri Kazanım Tesisi	Hazardous Waste Recycling
Öznak Hurdacılık Geri Dönüşümlü Atık Değ. Müh. Hiz. Orm. Ür. İnş. İşl. Mad. Pet. Ür. Otom. San. Tic. Ltd. Şti.	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Wastewater Discharge, Packaging Waste Recycling, End of life vehicle Temporary Storage, Packaging Waste Collection and Separation, Tank Cleaning, PCB Decontamination
Banplas Geri Dönüşüm İşlem. İnş. Harf. San. ve Tic. Ltd. Şti. (Hazardous Waste Recycling Facility)	Hazardous Waste Recycling
Altın Hurda Geri Dönüşüm Maddeleri Sanayi ve Ticaret Ltd. Şti.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Evren Metal Sanayi ve Ticaret Anonim Şirketi Bilecik Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Arslan Alüminyum Sanayi ve Ticaret Ltd. Şti. Bilecik 3. Şubesi	Air Emission, Wastewater Discharge, Scrap Metal/ End of life vehicle Processing, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Packaging Waste Recycling
Öztürkler Metal Sanayi ve Ticaret A. Ş.- Bilecik Şubesi	Air Emission, Hazardous Waste Recycling
Hünyan Mühendislik- Yakup Karagöz	Air Emission, Hazardous Waste Recycling
Metin Taylı- Meta Boya	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Ekmekçioğulları Metal ve Kimya San. Tic. A. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Beysu İnşaat Hurda Turizm Hayv. San. Tic. Ltd. Şti.	Hazardous Waste Recycling, Tank Cleaning
Süleyman Bilal- Bilal Varil	Hazardous Waste Recycling, Tank Cleaning

Firm Name	Allowance License Issues
Koruma Klor Alkali Sanayi ve Ticaret Anonim Şirketi Denizli Şubesi	Air Emission, Hazardous Waste Recycling
Denizli Varil Plastik Kağıt ve Ambalaj Ürünleri Katı Atık Geri Kaz. İnş. Tur. San. Tic. Ltd. Şti.	Hazardous Waste Recycling
Beysu Atık Yönetimi San. ve Tic. Ltd. Şti.	Air Emission, Packaging Waste Recycling, Tank Cleaning, Waste of Electrical and Electronic Equipment Processing, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Özvar Endüstriyel Atıklar Geri Dönüş. San. Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Kudret Metal İzabe Sanayii İşl. ve Tic. A. Ş. Eskişehir Şubesi	Air Emission, Hazardous Waste Recycling, Waste Batteries and Accumulator Recycling, Non-hazardous Waste Recycling
Ekolojik Enerji Anonim Şirketi Eskişehir Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Waste Interim Storage
Eşçev Mühendislik Çevre Danış. Mad. İnş. Taah. San Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Packaging Waste Recycling, Waste of Electrical and Electronic Equipment Processing, Packaging Waste Collection and Separation, Tank Cleaning
GEC Kimya Gıda Turz. ve Tarım Ür. San Tic. A. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Arkim Boya Kimya Geri Dönüşüm Sanayi ve Ticaret Limited Şirketi	Tank Cleaning, Hazardous Waste Recycling
KUSVA Petrol Dağıtım Nakliye Pazarlama Sanayi ve Ticaret Limited Şirketi	Tank Cleaning, Hazardous Waste Recycling
AKIM Akü Sanayi- Kerim Gündoğan	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Waste Batteries and Accumulator Recycling
BELİCE Geri Dönüşüm Geri Kazanım San. İç ve Dış Tic. Ltd. Şti.	Hazardous Waste Recycling, Tank Cleaning
Koruma Klor Alkali San. ve Tic. A. Ş. Kırıkhan Şubesi	Air Emission, Wastewater Discharge, Hazardous Waste Recycling
Özbek Kimya Tekstil Plastik Demir Çelik San. ve Tic. Ltd. Şti	Air Emission, Hazardous Waste Recycling
Befesa Silvermet İskenderun Çelik Tozu Geri Dönüşüm A. Ş.	Air Emission, Hazardous Waste Recycling
Aytaç Hanoğlu- Erzin Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Scrap Metal/ End of life vehicle Processing, Hazardous Waste Processing, Waste of Electrical and Electronic Equipment Processing
Ertunç Geri Kazanım ve Hurda San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Tank Cleaning

Firm Name	Allowance License Issues
Erbosan Erciyas Boru Sanayi ve Ticaret A. Ş. Çinko Oksit Ger Kazanım Tesisi	Air Emission, Hazardous Waste Recycling
Çinkom Çinko Kurşun Metal ve Madencilik San. Tic. A. Ş.	Air Emission, Hazardous Waste Recycling
Bozkurtlar Metal San. ve Tic. Ltd. Şti. Kırklareli Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Efe Alüminyum San. ve Tic. Ltd. Şti. A. Ş. Kırklareli Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Maramara Geri Dönüşüm ve Taşımacılık Kemal Kutbay Kırklareli Şubesi	Hazardous Waste Recycling
Lurec Kimya ve Destilasyon Sanayi ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Waste Oil Recycling
Ataberk Endüstri Kimya Nak. San. Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Waste Oil Recycling
Petro Kimya Atık Sintine ve Solv. Geri Kaz. Madeni ve End. Yağ Biyodizel Petrol San. Tic. A. Ş.	Air Emission, Hazardous Waste Recycling, Waste Oil Recycling
İrfan Çapan- Çapanoğlu Varil Ticaret	Air Emission, Wastewater Discharge, Hazardous Waste Recycling, Tank Cleaning
Konyalılar Geri Dön. Ve Ber. Tes. Me. Ma. İn. San ve T. A. Ş.	Hazardous Waste Recycling
Biokent Geri Dönüşüm Nakliyat Makine Otomotiv ve Dış Ticaret Limited Şirketi	Hazardous Waste Recycling
Kontamine Metal Geri Kazanım San. Tic. Ltd. Şti.	Hazardous Waste Recycling
Çev- Pet Petrol Ürünleri Geri Dön. Kim. Nak. San. Tic. A. Ş. (Konya Tesisi)	Air Emission, Hazardous Waste Recycling, Waste Oil Recycling
BIOMET Geri Dönüşüm Nak. Makine Otomotiv ve Dış Tic. A. Ş.	Hazardous Waste Recycling
ACİÖZ Petrol Hurdacılık Nakliye Demir Ürünleri San.ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Waste Oil Recycling
Mustafa ve Kudret Kardeşler Geri Dönüşüm Hurda Metal Nakliyat İnşaat Sanayi ve Ticaret Limited Şirketi	Hazardous Waste Recycling
Eti Gümüş Anonim Şirketi Kütahya Şubesi	Wastewater Discharge, Air Emission, Hazardous Waste Recycling, Landfill- First Class (Hazardous Waste Landfill)
Mutlu Akü ve Malzemeleri Sanayi A. Ş. Gediz Tesisi	Air Emission, Wastewater Discharge, Waste Batteries and Accumulator Recycling, Hazardous Waste Recycling, Non-hazardous Waste Recycling

Firm Name	Allowance License Issues
Ekomar Geri Dönüşüm Kimya Sanayi ve Ticaret Ltd. Şti.	Wastewater Discharge, Hazardous Waste Recycling, Tank Cleaning
Haşimoğlu Metal Hurda Geri Dönüşüm	Air Emission, Packaging Waste Collection and Separation, Waste of Electrical and Electronic Equipment Processing, Hazardous Waste Recycling
Seçmehan Kuyumculuk Gıda İnşaat ve Ticaret Limited Şirketi	Hazardous Waste Recycling
Sercan Madencilik Hizm Otom. İnş. Gıda Nakl. San. ve Tic.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Ak Metal Sanayi ve Ticaret Ltd. Şti.	Air Emission, Non-hazardous Waste Recycling, Waste Batteries and Accumulator Recycling, Hazardous Waste Recycling
Er Metal Madencilik Sanayi ve Ticaret Limited Şirketi Acıgöl Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Varilci Geri Dönüşüm San. ve Tic. Ltd. Şti.	Wastewater Discharge, Hazardous Waste Recycling, Tank Cleaning
Çelikler Metal Bakır ve Kablo Ür. Paz. San. ve Tic. Ltd. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Bor Elektrolitik Bakır Sanayi ve Ticaret A. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Adaylar Kablo Bakır Metal Plastik Geri Dönüşüm San. ve Tic. Ltd. Şti. Bor Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Niğde Plastik Anonim Şirketi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Packaging Waste Recycling
Hakan Abaklı- Hakan Ticaret	Hazardous Waste Recycling
Halil Kayıkcı Atık Geri Kazanım Sanayi ve Ticaret Anonim Şirketi	Air Emission, Non-hazardous Waste Recycling, Tank Cleaning, Hazardous Waste Recycling
Yeşil Enerji Bertaraf Geri Kazanım Sanayi ve Ticaret Anonim Şirketi	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Eker Geri Dönüşüm Nakliye İhracat İthalat Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling
Emine Çınar- Çınar Ticaret	Non-hazardous Waste Recycling, Hazardous Waste Recycling
Sarmet-San Plastik Metal İnş. Kağıt San. ve Tic. Ltd. Şti. Yalinyazı Kasabası Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Waste of Electrical and Electronic Equipment Processing
Bey Yağ Sanayi Ticaret Ltd. Şti.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Ramazan Çiçek- Çiçek Geri Dönüşüm	Air Emission, Hazardous Waste Recycling

Firm Name	Allowance License Issues
Hakkı Paçacı	Hazardous Waste Recycling, Tank Cleaning
Aksa DMG Değerli Madenler Geri Dönüşüm Kurşun İzabe San. Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Waste Batteries and Accumulator Recycling
Öztuğrul Metal Nakliye İnşaat Maden Tarım Sanayi ve Ticaret Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Waste Batteries and Accumulator Recycling
Öz Ülger Geri Dönüşüm Hurda Nakliyat Taah. Tic. Ve San. Ltd. Şti.	Hazardous Waste Recycling
Ak-Kim Kimya Sanayi ve Ticaret Anonim Şirketi Yalova Şubesi (İnorganik Tesisler)	Air Emission, Wastewater Discharge, Hazardous Waste Recycling, Tank Cleaning
Marzinc Maramara Geri Kazanım Sanayi ve Ticaret Anonim Şirketi Karabük Şubesi	Air Emission, Hazardous Waste Recycling
Ral Geri Dönüşüm Çelik San. ve Tic. A. Ş. -2	End of life vehicle Temporary Storage, Hazardous Waste Recycling
F-B Oil Petrol Petrol Ürünleri Maden Yağ Atık Geri Kazanım Tesisi ve Biodizel Üretim Dağıtım Pazarlama San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Waste Oil Recycling
Demirtaş Metal Alüminyum Turizm San. ve Tic. Ltd. Şti.	Air Emission, Non-hazardous Waste Recycling, Hazardous Waste Recycling
GEP Yeşil Enerji Üretim Teknolojileri Limited Şirketi Düzce Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Waste Interim Storage, Packaging Waste Collection and Separation
Çözüm End. Atık İşleme San. A. Ş.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Ülkem Metal Geri Dönüşüm ve Kazanım (Özlem Memicioğlu)	Hazardous Waste Recycling
Hamzaoğulları Metal Nak. Hurda Oto. İnş. İth. İhr. San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Güm San Gümüş Pazarlama Nakliyat Atık San. ve Tic. Ltd. Şti.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Ceylan Grup Metal Oksit Kimya Üretim Makina Hurda İthalat İhracat Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Çolakoğulları Hurdacılık Geri Dönüşüm Otomotiv İnş. Taah. Makina Yedek Parçaları Paz. San Tic. Ltd. Şti.	Hazardous Waste Recycling
Son-Ka Geri Dönüşüm ve Bertaraf Müşavirlik Makina Lojistik Limitee Şirketi Kazan Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Abra Atık İletişim Mak. A. Ş.	Hazardous Waste Recycling, Packaging Waste Recycling

Firm Name	Allowance License Issues
Koyuncu Soymetal San. Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Abak Tic. Ve San. Adi Komantid Şti. Ender Galip İşler ve Ortağı	Wastewater Discharge, Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Şefkat Metal Geri Dönüşüm İmal San. ve Tic. Ltd. Şti. Sincan Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Şahin Öztekin- Batuhan Geri Kazanım Hurdacılık ve Taşımacılık	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Gürsoy İzabelik Geri Dönüşüm Metal Nakliyat İnşaat Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling
MNC Akü Metal Nakliye Kuyumculuk San. ve Tic. A. Ş. ASO 2 Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Waste Batteries and Accumulator Recycling
Mesut Grup Alüminyum Metal Geri Kazanım Tesisi Nakliye Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling
Vakıf Sarı- Aksa Metal	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Morkaya Geri Dönüşüm Otomotiv Taşımacılık İnşaat Değerli Metaller Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling
Tim Geri Dönüşüm Ambalajlama Kimya Maden Metal İnşaat Otomotiv Sanayi Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling
Alla Metal Geri Dönüşüm Nakliyat Sanayi ve Ticaret Limited Şirketi	Air Emission, Non-hazardous Waste Recycling, Hazardous Waste Recycling
Enc Metal Geri Dönüşüm İnşaat Sanayi Ticaret Anonim Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Mitat Şahin	Hazardous Waste Recycling
Evciler Kimya Mad. ve Değ. Met. San. Tic. A. Ş.	Air Emission, Hazardous Waste Recycling, Waste of Electrical and Electronic Equipment Processing
Ambalaj Atıkları Depolama Taşıma ve Geri Dönüşüm/ Selami Engin	Air Emission, Non-hazardous Waste Recycling, Hazardous Waste Recycling, Packaging Waste Recycling, Tank Cleaning, Waste of Electrical and Electronic Equipment Processing
Saha Metal Sanayi Ticaret Limited Şti.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Ceylan Grup Metal Oksit Kimya Üretim Makine Hurda İthalat İhracat San. ve Tic. Ltd. Şti. Kazan Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling
İlkem Çevre Geri Dönüşüm Danışmanlık Nakliyat Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling

Firm Name	Allowance License Issues
ÇH Makina Mühendislik Danışmanlık Madencilik Tehlikeli Atık Sanayi ve Ticaret Limited Şirketi Kazan Şubesi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Serhat Atık Geri Kazanım Madencilik Enerji Üretim Sanayi ve Ticaret A. Ş. Kazan Ankara Şubesi	Non-hazardous Waste Recycling, Packaging Waste Recycling, Packaging Waste Collection and Separation, Hazardous Waste Recycling
Civan Geri Dönüşüm İzalosyan Plastik Metal İnş. Taah. San. ve Tic. Ltd. Şti.	Air Emission, Tank Cleaning, Hazardous Waste Recycling
İtimat Atık Yönetimi Geri Dönüşüm Metal Ambalaj Atıkları Nakliye San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Packaging Waste Collection and Separation
Genkim Genel Endüstriyel Kimyevi Maddeler San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Scholz Metal Nakliye Geri Dönüşüm San. ve Tic. Ltd. Şti.	Hazardous Waste Recycling, Scrap Metal/ End of life vehicle Processing
Er-Ka Kağıt ve Ambalaj Sanayi Ticaret Limited Şirketi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Packaging Waste Recycling, Packaging Waste Collection and Separation, Tank Cleaning
Karataş Demir Çelik Sanayi ve Ticaret Limited Şirketi	Hazardous Waste Recycling, Packaging Waste Collection and Separation, Scrap Metal/ End of life vehicle Processing
Rudolf Duraner Kimyevi Maddeler Tic. Ve San. A. Ş.	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Dekasan Dönüştürülebilir Endüstriyel Katı Atık Nakliye Sanayi ve Ticaret Limited Şirketi	Hazardous Waste Recycling, Packaging Waste Collection and Separation, Scrap Metal/ End of life vehicle Processing
Kurtlar Hurda Geri Dönüşüm Nakliyat Sanayi ve Tic. Ltd. Şti. Bursa Nilüfer Şubesi	Hazardous Waste Recycling, Packaging Waste Collection and Separation
Ferroalloys Metal Hurda Ambalaj Atıkları Geri Dönüşüm Sanayi ve Ticaret Limited Şirketi	Hazardous Waste Recycling, Packaging Waste Collection and Separation
Ortaklar Geri Dönüşüm Hurda Plastik Metal Nakliye Sanayi ve Ticaret Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Tank Cleaning
İnova Geri Dönüşüm Metal Taşımacılık ve Endüstriyel Temizlik Sanayi ve Ticaret Ltd. Şti.	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Scrap Metal/ End of life vehicle Processing, Waste of Electrical and Electronic Equipment Processing
Emniyetli Hurda Geri Dönüşüm İletişim Tekstil Otomotiv Nakliyat İnşaat Sanayi ve Ticaret Limited Şirketi	Air Emission, Packaging Waste Recycling, End of life vehicle Temporary Storage, Packaging Waste Collection and Separation, Hazardous Waste Recycling, Non-hazardous Waste Recycling

Firm Name	Allowance License Issues
Vebsan Endüstriyel Atık San. ve Tic. Ltd. Şti.	Hazardous Waste Recycling
Mahmut Akgül	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Ali Bağcı- Eska Metal	Hazardous Waste Recycling
Taşmetal Kimya San. ve Tic. Ltd. Şti.	Hazardous Waste Recycling
Hasturk Geri Dönüşüm Sanayi Tic. Ltd. Şti.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Aype Medikal ve Gümüş Geri Kazanım Makinaları	Hazardous Waste Recycling
Seyhan Medikal ve Gümüş Gerikazanım San. Tic. Ltd. Şti.	Hazardous Waste Recycling
Kahyaoğulları Hurdacılık San. Tic. Ltd. Şti İstanbul Tuzla Şubesi	Air Emission, Tank Cleaning, Hazardous Waste Recycling
Kurtyıldız Kimya Sanayi- Orhan Kurtoğlu	Hazardous Waste Recycling
Gözde Kimya Medikal Gümüş Geri Dönüşüm- Erol Büyükoğuz	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Ertaş Metal San. ve Tic. A. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Keskinler Alüminyum Metal Makine ve Endüstriyel Ürünleri Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Nergis Fotoğrafçılık Banyo Atıksuyu Toplama ve İşleme- Mustafa Kasap	Hazardous Waste Recycling, Non-hazardous Waste Recycling
NCG Metal ve Plastik Ambalaj Yenileme San. ve Tic. A. Ş. İstanbul Şubesi	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Bilgi Metal Metalurji Makina Gıda Maddeleri İhracat ve İthalat Sanayi Ticaret Limited Şirketi	Noise Control, Air Emission, Hazardous Waste Recycling
Egemen Kimya Endüstriyel Malzemeler Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Bilgi Geri Dönüşüm ve Lojistik Sanayi Dış Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling
Metal-Kim Metalurji ve Kimya Tarım San. Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Oruçoğulları Alüminyum Külçe San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Packaging Waste Recycling
Remle Kimya Matbaacılık Turizm İnşaat Sanayi ve Ticaret Limited Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Pireks Bakır Alaşımları Sanayi ve Tic. A. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Dedeoğlu Hurda Nak. ve Kimyasalları Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Tank Cleaning

Firm Name	Allowance License Issues
Akademi Çevre Danışmanlık Hiz. İnş. San. ve Tic. Ltd. Şti.	Air Emission, PCB Decontamination, Non-hazardous Waste Recycling, Hazardous Waste Recycling, Waste Interim Storage, Waste of Electrical and Electronic Equipment Processing, Scrap Metal/ End of life vehicle Processing,
Sayan Metal	Air Emission, Hazardous Waste Recycling
Yıldız Metal San. ve Tic. A. Ş.	Air Emission, Non-hazardous Waste Recycling, Hazardous Waste Recycling
Onsa Mücevherat İmalatı ve Dış Ticaret Anonim Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Akademi Geri Dönüşüm Sanayi ve Ticaret Limited Şirketi	Air Emission, Non-hazardous Waste Recycling, Hazardous Waste Recycling
Şahinler Metal Sanayi ve Ticaret A. Ş. İstanbul Şubesi	Air Emission, Non-hazardous Waste Recycling, Hazardous Waste Recycling, Packaging Waste Recycling, Packaging Waste Collection and Separation, Scrap Metal/ End of life vehicle Processing
Tuzla Deri OSB Geri Dönüşüm Anonim Şirketi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Waste Interim Storage, Packaging Waste Collection and Separation
Emre Metal Dış Ticaret Ltd. Şti.	Hazardous Waste Recycling, Waste of Electrical and Electronic Equipment Processing
Topaloğlu Metal	Air Emission, Hazardous Waste Recycling
Daşdan Metal Hurdacılık Geri Dönüşüm ve Nakliye Tic. Ltd. Şti.	Hazardous Waste Recycling
Daşdanlar Metal Hurdacılık Geri Dönüşüm Gıda San. ve Nak. Tic. Ltd. Şti.	Hazardous Waste Recycling
Gülbahçe Metal Kimyasan ve Tic. Ltd. Şti.	Hazardous Waste Recycling
Bıyıklar Metal Geri Kazanım ve Nakliye San. Tic. Ltd. Şti.	Hazardous Waste Recycling
Dönmez Varil Geri Dönüşüm San. ve Tic. Ltd. Şti.	Wastewater Discharge, Air Emission, Hazardous Waste Recycling, Tank Cleaning
İdamet Metal Makina İnşaat Hurda Danışmanlık Taşımacılık San. ve Tic. Ltd. Ş.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Mekay Döküm Hurda Sanayi ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Binka Alüminyum Döküm Sanayi ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Akyol Hurdacılık Geri Dönüşüm Kantar Nakliye ve Makine Sanayi Ticaret Ltd. Şti. - Torbalı Şubesi	Hazardous Waste Recycling

Firm Name	Allowance License Issues
Aktif Kimya San. ve Tic. Ltd. Şti İTOB Organize Sanayi Şubesi	Air Emission, Hazardous Waste Recycling
Çınar Boya Kimya Tur. Nak. Hır. Dem. Akaryakıt Otomotiv Geri Dönüşüm İth. İhr. San. ve Tic. A. Ş.	Air Emission, Hazardous Waste Recycling
Pagem Geri Kazanım Sanayi Ticaret- Recai Çınkan	Air Emission, Hazardous Waste Recycling, Packaging Waste Collection and Separation
Ekin Metal Kimya Ticaret- Ekin Solak	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Sate Gıda ve Kimya San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Özdenizcilik Ulaştırma Gemi Sök. Tur. Dem. Su Spor. Atık Mad. San. ve Tic. A. Ş.	Hazardous Waste Recycling, Non- hazardous Waste Recycling, Scrap Metal/ End of life vehicle Processing
Argesu Kimya Müh. Geri Dönüşümlü Enerji San Zirai Ürün Plastik Geri Kazanım San ve Tic. Ltd. Şti.	Hazardous Waste Recycling
Tuncay Sabırlı (Niğsa Metal ve Gemi Söküm Taahhüt Ticaret)	Air Emission, Hazardous Waste Recycling
Ercan Döküm Metal Petrol Tekstil Gıda Nakliye Hurda Turizm Sanayi ve Ticaret Ltd. Şti. - Menderes Şubesi	Air Emission, Hazardous Waste Recycling
Şah Metalurji Geri Dön. Ve Dök. İml. San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling
Kılıçoğulları Geri Dönüşüm Nak. Metal İnş. Taah. San. ve Tic. Ltd. Şti.	Hazardous Waste Recycling
Kayacan Döküm Metalalü Pet. Nak. Hur. Turz. S. ve T. L. Ş.	Air Emission, Hazardous Waste Recycling
Hayrullah Batuhan Akdağ- Akdağ Alüminyum Torbalı Şubesi	Air Emission, Hazardous Waste Recycling
BNS Atık Yönetimi Lojistik Maden ve Kimya Enerji İnşaat Sanayi ve Ticaret Limited Şirketi	Waste Interim Storage, Hazardous Waste Recycling
Çinkanalar Kimyevi Maddeler Ticaret ve Sanayi A. Ş.	Wastewater Discharge, Air Emission, Hazardous Waste Recycling, Waste Oil Recycling, Tank Cleaning
Grup Boya ve Kimya San. Tic. A. Ş.	Air Emission, Hazardous Waste Recycling
Kartel Metal Hurdacılık Nakliyat Taahhüt Gıda Market İnşaat Hafriyat Sanayi ve Ticaret Limited Şirketi	Hazardous Waste Recycling
Elsan Hammade Sanayi Anonim Şirketi	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Özbiçerler Metal ve Geri Dönş. Metal Atık. Topl. Ve Ayrş. Tes. San. Tic. Ltd. Şti.	Hazardous Waste Recycling

Firm Name	Allowance License Issues
Süreko Atık Yönetimi Nakliye Lojistik Elektrik Üretim A.Ş. Kula Şubesi	Air Emission, Wastewater Discharge, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Landfill- First Class (Hazardous Waste Landfill), Waste Interim Storage, Packaging Waste Collection and Separation
Baldır Geri Dönüşüm Am. At. Top. Ayr. ve Metal İnş. Nak. San. Tic. Ltd. Şti.	Waste of Electrical and Electronic Equipment Processing, Packaging Waste Collection and Separation, Hazardous Waste Recycling
Has Niğdeliler Hurda Ticareti Turgutlu Şubesi- Ali Temurtaş	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Sahalar Metal Demir Çelik Hur. Nak. Harf. İnş. Taah. İth. İhr. San. ve Tic. Ltd. Şti.	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Packaging Waste Recycling, Packaging Waste Collection and Separation, Tank Cleaning, Waste of Electrical and Electronic Equipment Processing
Başaranlar Demir Çelik İnş. Geri Dönüşüm San. ve Tic. A. Ş. Manisa Şubesi	Air Emission, Non-hazardous Waste Recycling, Packaging Waste Recycling, Hazardous Waste Recycling, Packaging Waste Collection and Separation, Tank Cleaning, Waste of Electrical and Electronic Equipment Processing
Paşaoğlu Metal Geri Dönüşüm Demir Çelik İnşaat Odun Kömür Hafriyat Nakliyat Turizm İthalat İhracat Sanayi ve Ticaret Limited Şirketi	Hazardous Waste Recycling, Packaging Waste Collection and Separation
Aşuroğulları Tehlikeli Atıklar Ön İşl. Ara Depolama Nak. ve Hurda San. Dış. Tic. Ltd. Şti. Manisa Şub.	Hazardous Waste Recycling, Non-hazardous Waste Recycling
Çiçek Katı Atıklar Geri Dönüşüm Sanayi ve Nakliyat Ticaret Limited Şirketi	Wastewater Discharge, Air Emission, Hazardous Waste Recycling, Tank Cleaning
Hakan Çakıroğlu Pay Plastik Geri Dönüşüm ve Geri Kazanım	Wastewater Discharge, Air Emission, Hazardous Waste Recycling
Gülcan Metal Sanayi ve Ticaret Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Luna Geri Dönüşüm Plastik San. ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Ağaoğlu Katı Atıklar Geri Dön. San. ve Tic. Ltd. Şti.	Hazardous Waste Recycling, Tank Cleaning
Sarbak Metal Ticaret ve Sanayi A. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling
Altun Metal Plastik Ambalaj Sanayi ve Tic. Ltd. Şti.	Air Emission, Hazardous Waste Recycling, Tank Cleaning
Mutlu Geri Dönüşüm Sanayi ve Ticaret Limited Şirketi	Wastewater Discharge, Hazardous Waste Recycling, Non-hazardous Waste Recycling

Firm Name	Allowance License Issues
Mesek Metal San. ve Tic. A. Ş.	Air Emission, Hazardous Waste Recycling, Non-hazardous Waste Recycling, Packaging Waste Recycling
Ekolojik Enerji A. Ş. Çorlu Şubesi	Hazardous Waste Recycling, Non-hazardous Waste Recycling, Landfill- First Class (Hazardous Waste Landfill), Waste Interim Storage, Packaging Waste Collection and Separation
Erdoğan Solak- Alp Plastik Geri Dönüşüm, Geri Kazanım ve Tehlikeli Atıklar Tesisi	Tank Cleaning, Hazardous Waste Recycling
Barkın Plastik Sanayi Ticaret Limited Şirketi Çorlu Şubesi	Air Emission, Wastewater Discharge, Hazardous Waste Recycling, Packaging Waste Recycling, Non-hazardous Waste Recycling
Ay-Yıl Plastik Hurdamet. Nak. İç ve Dış Tic. Ltd. Şti.	Wastewater Discharge, Hazardous Waste Recycling, Tank Cleaning

Appendix-C: Hazardous Waste List in Waste Management Regulation

The hazardous waste list shown in Table D-1 was adapted from Council Directive 91/689/EC on hazardous waste and (A) and (M) marks are valid only for Waste Management Regulation of Turkey.

In the list, (A) marked waste is classified as hazardous waste without making analysis.

In the list, (M) marked waste indicates that the waste is potentially hazardous waste. In order to determine whether it is hazardous or not, the study on the determination of hazard characteristics of waste in Article 11 of Waste Management Regulation is carried out.

Table C-1: Hazardous Waste List in Waste Management Regulation [2], [5]

01	WASTE RESULTING FROM EXPLORATION, MINING, QUARRYING, AND PHYSICAL AND CHEMICAL TREATMENT OF MINERALS	
01 03	Wastes from Physical and Chemical Processing of Metalliferous Minerals	
01 03 04*	Acid-generating tailings from processing of sulphide ore	A
01 03 05*	Other tailings containing dangerous substances	M
01 03 07*	Other wastes containing dangerous substances from physical and chemical processing of metalliferous minerals	M
01 04	Wastes From Physical and Chemical Processing of Non-Metalliferous Minerals	
01 04 07*	Waste containing dangerous substances from physical and chemical processing of nonmetalliferous minerals	M
01 05	Drilling Muds and Other Drilling Wastes	
01 05 05*	Oil-containing drilling muds and wastes	A
01 05 06*	Drilling muds and other drilling wastes containing dangerous substances	M
02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING	
02 01	Wastes from Agriculture, Horticulture, Aquaculture, Forestry, Hunting and Fishing	
02 01 08*	Agrochemical waste containing dangerous substances	M
03	WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS(CHIPBOARD) AND FURNITURE, PULP, PAPER AND CARDBOARD	
03 01	Wastes from wood processing and the production of panels and furniture	
03 01 04*	Sawdust, shavings, cuttings, wood, particle board and veneer containing dangerous substances ⁽¹⁾	M
03 02	Wastes from Wood Preservation	
03 02 01*	Non-halogenated organic wood preservatives	A

03 02 02*	Organochlorinated wood preservatives	A
03 02 03*	Organometallic wood preservatives	A
03 02 04*	Inorganic wood preservatives	A
03 02 05*	Other wood preservatives containing dangerous substances	M
04	WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES	
04 01	Wastes from the Leather and Fur Industry	
04 01 03*	Degreasing wastes containing solvents without a liquid phase	M
04 02	Wastes from the Textile Industry	
04 02 14*	Wastes from finishing containing organic solvents	M
04 02 16*	Dyestuffs and pigments containing dangerous substances	M
04 02 19*	Sludge from on-site effluent treatment containing dangerous substances	M
05	WASTES FROM PETROLEUM REFINING, NATURAL GAS PURIFICATION AND PYROLYTIC TREATMENT OF COAL	
05 01	Wastes from Petroleum Refining	
05 01 02*	Desalted sludge	A
05 01 03*	Tank bottom sludge	A
05 01 04*	Acid alkyl sludge	A
05 01 05*	Oil spills	A
05 01 06*	Oily sludge from maintenance operations of the plant or equipment	A
05 01 07*	Acid tars	A
05 01 08*	Other tars	A
05 01 09*	Sludge from on-site effluent treatment containing dangerous substances	M
05 01 11*	Wastes from cleaning of fuels with bases	A
05 01 12*	Oil containing acids	A
05 01 15*	Spent filter clays	A
05 06	Waste from the Pyrolytic Treatment of Coal	
05 06 01*	Acid tars	A
05 06 03*	Other tars	A
05 07	Waste from Natural Gas Purification and Transportation	
05 07 01*	Wastes containing mercury	M
06	WASTES FROM INORGANIC CHEMICAL PROCESSES	
06 01	Wastes from the Manufacture, Formulation, Supply and Use (MFSU) of Acids	
06 01 01*	Sulphuric acid and sulphurous acid	A
06 01 02*	Hydrochloric acid	A
06 01 03*	<u>Hydrofluoric acid</u>	A
06 01 04*	Phosphoric and phosphorous acid	A
06 01 05*	Nitric acid and nitrous acid	A
06 01 06*	Other acids	A
06 02	Wastes from the MFSU of Bases	
06 02 01*	Calcium hydroxide	A
06 02 03*	Ammonium hydroxide	A
06 02 04*	Sodium and potassium hydroxide	A
06 02 05*	Other bases	A

06 03	Wastes from the MFSU of Salts and Their Solutions and Metallic Oxides	
06 03 11*	Solid salts and solutions containing cyanides	M
06 03 13*	Solid salts and solutions containing heavy metals	M
06 03 15*	Metallic oxides containing heavy metals	M
06 04	Metal-Containing Wastes Other Than Those Mentioned in 06 03	
06 04 03*	Wastes containing arsenic	M
06 04 04*	Wastes containing mercury	M
06 04 05*	Wastes containing other heavy metals	M
06 05	Sludge from On-Site Effluent Treatment	
06 05 02*	Sludge from on-site effluent treatment containing dangerous solutions	M
06 06	Wastes from the MFSU of Sulphur Chemicals, Sulphur Chemical Processes and Desulphurisation Processes	
06 06 02*	Wastes containing dangerous sulphides	M
06 07	Wastes from the MFSU of Halogens and Halogen Chemical Processes	
06 07 01*	Wastes containing asbestos from electrolysis	M
06 07 02*	Activated carbon from chlorine production	A
06 07 03*	Barium sulphate sludge containing mercury	M
06 07 04*	Solutions and acids, for example contact acid	A
06 08	Wastes from the MFSU of Silicon and Silicon Derivatives	
06 08 02*	Waste containing dangerous silicones	M
06 09	Wastes from the MFSU of Phosphorus Chemicals and Phosphorous Chemical Processes	
06 09 03*	Calcium-based reaction wastes containing or contaminated with dangerous substances	M
06 10	Wastes from the MFSU of Nitrogen Chemicals, Nitrogen Chemical Processes and Fertiliser Manufacture	
06 10 02*	Wastes containing dangerous substances	M
06 13	Wastes from Inorganic Chemical Processes Not Otherwise Specified	
06 13 01*	Inorganic plant protection products, wood-preserving agents and other biocides	A
06 13 02*	Spent activated carbon (except 06 07 02)	A
06 13 04*	wastes from asbestos processing	A
06 13 05*	Soot	A
07	WASTES FROM ORGANIC CHEMICAL PROCESSES	
07 01	Wastes from the Manufacture, Formulation, Supply and Use (MFSU) of Basic Organic Chemicals	
07 01 01*	Aqueous washing liquids and mother liquors	A
07 01 03*	Organic halogenated solvents, washing liquids and mother liquors	A
07 01 04*	Other organic solvents, washing liquids and mother liquors	A
07 01 07*	Halogenated still bottoms and reaction residues	A
07 01 08*	Other still bottoms and reaction residues	A
07 01 09*	Halogenated filter cakes and spent absorbents	A
07 01 10*	Other filter cakes and spent absorbents	A

07 01 11*	Sludge from on-site effluent treatment containing dangerous substances	M
07 02	Wastes from the MFSU of Plastics, Synthetic Rubber and Man-Made Fibres	
07 02 01*	Aqueous washing liquids and mother liquors	A
07 02 03*	Organic halogenated solvents, washing liquids and mother liquors	A
07 02 04*	Other organic solvents, washing liquids and mother liquors	A
07 02 07*	Halogenated still bottoms and reaction residues	A
07 02 08*	Other still bottoms and reaction residues	A
07 02 09*	Halogenated filter cakes and spent absorbents	A
07 02 10*	Other filter cakes and spent absorbents	A
07 02 11*	Sludge from on-site effluent treatment containing dangerous substances	M
07 02 14*	Wastes from additives containing dangerous substances	M
07 02 16*	Waste containing dangerous silicones	M
07 03	Wastes from the MFSU of Organic Dyes and Pigments (except 06 11)	
07 03 01*	Aqueous washing liquids and mother liquors	A
07 03 03*	Organic halogenated solvents, washing liquids and mother liquors	A
07 03 04*	Other organic solvents, washing liquids and mother liquors	A
07 03 07*	Halogenated still bottoms and reaction residues	A
07 03 08*	Other still bottoms and reaction residues	A
07 03 09*	Halogenated filter cakes and spent absorbents	A
07 03 10*	Other filter cakes and spent absorbents	A
07 03 11*	Sludge from on-site effluent treatment containing dangerous substances	M
07 04	Wastes from the MFSU of Organic Plant Protection Products (Except 02 01 08 And 02 01 09), Wood Preserving Agents (Except 03 02) and Other Biocides	
07 04 01*	Aqueous washing liquids and mother liquors	A
07 04 03*	Organic halogenated solvents, washing liquids and mother liquors	A
07 04 04*	Other organic solvents, washing liquids and mother liquids	A
07 04 07*	Halogenated still bottoms and reaction residues	A
07 04 08*	Other still bottoms and reaction residues	A
07 04 09*	Halogenated filter cakes and spent absorbents	A
07 04 10*	Other filter cakes and spent absorbents	A
07 04 11*	Sludge from on-site effluent treatment containing dangerous substances	M
07 04 13*	Solid wastes containing dangerous substances	M
07 05	Wastes from the MFSU of Pharmaceuticals	
07 05 01*	Aqueous washing liquids and mother liquors	A
07 05 03*	Organic halogenated solvents, washing liquids and mother liquors	A
07 05 04*	Other organic solvents, washing liquids and mother liquors	A
07 05 07*	Halogenated still bottoms and reaction residues	A
07 05 08*	Other still bottoms and reaction residues	A

07 05 09*	Halogenated filter cakes and spent absorbents	A
07 05 10*	Other filter cakes and spent absorbents	A
07 05 11*	Sludge from on-site effluent treatment containing dangerous substances	M
07 05 13*	Solid wastes containing dangerous substances	M
07 06	Wastes from the MFSU of Fats, Grease, Soaps, Detergents, Disinfectants and Cosmetics	
07 06 01*	Aqueous washing liquids and mother liquors	A
07 06 03*	Organic halogenated solvents, washing liquids and mother liquors	A
07 06 04*	Other organic solvents, washing liquids and mother liquors	A
07 06 07*	Halogenated still bottoms and reaction residues	A
07 06 08*	Other sill bottoms and reaction residues	A
07 06 09*	Halogenated filter cakes and spent absorbents	A
07 06 10*	Other filter cakes and spent absorbents	A
07 06 11*	Sludge from on-site effluent treatment containing dangerous substances	M
07 07	Wastes from the MFSU of Fine Chemicals and Chemical Products Not Otherwise Specified	
07 07 01*	Aqueous washing liquids and mother liquors	A
07 07 03*	Organic halogenated solvents, washing liquids and mother liquors	A
07 07 04*	Other organic solvents, washing liquids and mother liquors	A
07 07 07*	Halogenated still bottoms and reaction residues	A
07 07 08*	Other still bottoms and reaction residues	A
07 07 09*	Halogenated filter cakes and spent absorbents	A
07 07 10*	Other filter cakes and spent absorbents	A
07 07 11*	Sludge from on-site effluent treatment containing dangerous substances	M
08	WASTES FORM THE MANUFACTURE, FORMULATION, SUPPLY AND USE (MFSU) OF COATINGS (PAINTS, VARNISHES AND VITREOUS ENAMELS,) ADHESIVES, SEALANTS AND PRINTING INKS	
08 01	Wastes from MFSU and Removal of Paint and Varnish	
08 01 11*	Waste paint and varnish containing organic solvents or other dangerous substances	M
08 01 13*	Sludge from paint or varnish containing organic solvents or other dangerous substances	M
08 01 15*	Aqueous sludge's containing paint or varnish containing organic solvents or other dangerous substances	M
08 01 17*	Wastes from paint or varnish removal containing organic solvents or other dangerous substances	M
08 01 19*	Aqueous suspensions containing paint or varnish containing organic solvents or other dangerous substances	M
08 01 21*	Waste paint or varnish remover	A
08 03	Wastes from MFSU of Printing Inks	
08 03 12*	Waste ink containing dangerous substances	M
08 03 14*	Ink sludge containing dangerous substances	M
08 03 16*	Waste etching solutions	A

08 03 17*	Waste printing toner containing dangerous substances	M
08 03 19*	Disperse oil	A
08 04	Wastes from MFSU of Adhesives and Sealants (Including Waterproofing Products)	
08 04 09*	Waste adhesives and sealants containing organic solvents or other dangerous substances	M
08 04 11*	Adhesive and sealant sludge containing organic solvents or other dangerous substances	M
08 04 13*	Aqueous sludge containing adhesives or sealants containing organic solvents or other dangerous substances	M
08 04 15*	Aqueous liquid waste containing adhesives or sealants containing organic solvents or other dangerous substances	M
08 04 17*	Rosin oil	A
08 05	Wastes Not Otherwise Specified in 08	
08 05 01*	Waste isocyanates	A
09	WASTES FROM THE PHOTOGRAPHIC INDUSTRY	
09 01	Wastes for the Photographic Industry	
09 01 01*	Water-based developer and activator solutions	A
09 01 02*	Water-based offset plate developer solutions	A
09 01 03*	Solvent-based developer solutions	A
09 01 04*	Fixed solutions	A
09 01 05*	Bleach solutions and bleach fixer solutions	A
09 01 06*	Wastes containing silver from on-site treatment of photographic wastes	M
09 01 11*	Single-use cameras containing batteries included in 16 06 01, 16 06 02 or 16 06 03	A
09 01 13*	Aqueous liquid waste from on-site reclamation of silver other than those mentioned in 09 01 06	A
10	WASTES FROM THERMAL PROCESSES	
10 01	Wastes from Power Stations and Other Combustion Plants (except 19)	
10 01 04*	Oil fly ash and boiler dust	A
10 01 09*	Sulphuric acid	A
10 01 13*	Fly ash from emulsified hydrocarbons used as fuel	A
10 01 14*	Bottom ash, slag and boiler dust from co-incineration containing dangerous substances	M
10 01 16*	Fly ash from co-incineration containing dangerous substances	M
10 01 18*	Wastes from gas cleaning containing dangerous substances	M
10 01 20*	Sludge from on-site effluent treatment containing dangerous substances	M
10 01 22*	Aqueous sludge from boiler cleansing containing dangerous substances	M
10 02	Wastes from The Iron and Steel Industry	
10 02 07*	Solid wastes from gas treatment containing dangerous substances	M
10 02 11*	Wastes from cooling-water treatment containing oil	M
10 02 13*	Sludge and filter cakes from gas treatment containing dangerous substances	M
10 03	Wastes from Aluminum Thermal Metallurgy	

10 03 04*	Primary production slags	A
10 03 08*	Salt slags from secondary production	A
10 03 09*	Black drosses from secondary production	A
10 03 15*	Skimmings that are flammable or emit, upon contact with water, flammable gases in dangerous quantities	A
10 03 17*	Tar-containing wastes from anode manufacture	A
10 03 19*	Flue-gas dust containing dangerous substances	M
10 03 21*	Other particulates and dust (including ball-mill dust) containing dangerous substances	M
10 03 23*	Solid wastes from gas treatment containing dangerous substances	M
10 03 25*	Sludge and filter cakes from gas treatment containing dangerous substances	M
10 03 27*	Wastes from cooling-water treatment containing oil	M
10 03 29*	Waste from treatment of salt slags and black drosses containing dangerous substances	M
10 04	Wastes from Lead Thermal Metallurgy	
10 04 01*	Slags from primary and secondary production	A
10 04 02*	Dross and skimmings from primary and secondary production	A
10 04 03*	Calcium arsenate	A
10 04 04*	Flue-gas dust	A
10 04 05*	Other particulates and dust	A
10 04 06*	Solid wastes from gas treatment	A
10 04 07*	Sludge and filter cakes from gas treatment	A
10 04 09*	Wastes from cooling-water treatment containing oil	M
10 05	Wastes from Zinc Thermal Metallurgy	
10 05 03*	Flue-gas dust	A
10 05 05*	Solid waste from gas treatment	A
10 05 06*	Sludge and filter cakes from gas treatment	A
10 05 08*	Wastes from cooling-water treatment containing oil	M
10 05 10*	Dross and skimmings that are flammable or emit, upon contact with water, flammable gases in dangerous quantities	A
10 06	Wastes from Copper Thermal Metallurgy	
10 06 03*	Flue-gas dust	A
10 06 06*	Solid wastes from gas treatment	A
10 06 07*	Sludge and filter cakes from has treatment	A
10 06 09*	Wastes from cooling-water treatment containing oil	M
10 07	Wastes from Silver, Gold and Platinum Thermal Metallurgy	
10 07 07*	Wastes from cooling-water treatment containing oil	M
10 08	Wastes from Other Non-Ferrous Thermal Metallurgy	
10 08 08*	Salt slag from primary and secondary production	A
10 08 10*	Dross and skimming that are flammable or emit, upon the contact with water, flammable gases in dangerous quantities	A
10 08 12*	Tar-containing waste from anode manufacture	A
10 08 15*	Flue-gas dust containing dangerous substances	M
10 08 17*	Sludge and filter cakes from flue-gas treatment containing dangerous substances	M
10 08 19*	Wastes from cooling-water treatment containing oil	M
10 09	Wastes from Casting of Ferrous Pieces	

10 09 05*	Casting cores and mould which have not undergone pouring containing dangerous substances	M
10 09 07*	Casting cores and mould which have undergone pouring containing dangerous substances	M
10 09 09*	Flue-gas dust containing dangerous substances	M
10 09 11*	Other particulates containing dangerous substances	M
10 09 13*	Waste binders containing dangerous substances	M
10 09 15*	Waste crack-indicating agent containing dangerous substances	M
10 10	Wastes from Casting of Non-Ferrous Pieces	
10 10 05*	Casting cores and mould which have not undergone pouring, containing dangerous substances	M
10 10 07*	Casting cores and mould which have undergone pouring, containing dangerous substances	M
10 10 09*	Flue-gas dust containing dangerous substances	M
10 10 11*	Other particulates containing dangerous substances	M
10 10 13*	Waste binders containing dangerous substances	M
10 10 15*	Waste crack-indicating agent containing dangerous substances	M
10 11	Wastes from Manufacture of Glass and Glass Products	
10 11 09*	Waste preparation mixture before thermal processing, containing dangerous substances	M
10 11 11*	Waste glass in small particles and glass powder containing heavy metals (for example from cathode ray tubes)	M
10 11 13*	Glass-polishing and -grinding sludge containing dangerous substances	M
10 11 15*	Solid wastes from flue-gas treatment containing dangerous substances	M
10 11 17*	Sludge and filter cakes from flue-gas treatment containing dangerous substances	M
10 11 19*	Solid wastes from on-site effluent treatment containing dangerous substances	M
10 12	Wastes from Manufacture of Ceramic Goods, Bricks, Tiles and Construction Products	
10 12 09*	Solid wastes from gas treatment containing dangerous substances	M
10 12 11*	Wastes from glazing containing heavy metals	M
10 13	Wastes from Manufacture of Cement, Lime and Plaster and Articles and Products Made from Them	
10 13 09*	Wastes from asbestos-cement manufacture containing asbestos	M
10 13 12*	Solid wastes from gas treatment containing dangerous substances	M
10 14	Waste from Crematoria	
10 14 01*	Waste from gas cleaning containing mercury	A
11	WASTES FROM CHEMICAL SURFACE TREATMENT AND COATING OF METALS AND OTHER MATERIALS; NON-FERROUS HYDRO-METALLURGY	
11 01	Wastes From Chemical Surface Treatment and Coating Of Metals And Other Materials (For Example Galvanic Processes, Zinc Coating Processes, Pickling Processes, Etching, Phosphating, Alkaline Degreasing, Anodising)	

11 01 05*	Pickling acids (slicking acids)	A
11 01 06*	Acids not otherwise specified	A
11 01 07*	Pickling bases	A
11 01 08*	Phosphatising sludge	A
11 01 09*	Sludge and filter cakes containing dangerous substances	M
11 01 11*	Aqueous rinsing liquids containing dangerous substances	M
11 01 13*	Degreasing wastes containing dangerous substances	M
11 01 15*	Eluate and sludge from membrane systems or ion exchange systems containing dangerous substances	M
11 01 16*	Saturated or spent ion exchange resins	A
11 01 98*	Other wastes containing dangerous substances	M
11 02	Waste From Non-Ferrous Hydrometallurgical Processes	
11 02 02*	Sludge from zinc hydrometallurgy (including jarosite, goethite)	A
11 02 05*	Wastes from copper hydrometallurgical processes containing dangerous substances	M
11 02 07*	Other wastes containing dangerous substances	M
11 03	Sludge and Solids from Tempering Processes	
11 03 01*	Waste containing cyanide	A
11 03 02*	Other wastes	A
11 05	Wastes from Hot Galvanising Processes	
11 05 03*	Solid wastes from gas treatment	A
11 05 04*	Spent flux	A
12	WASTES FROM SHAPING AND PHYSICAL AND MECHANICAL SURFACE TREATMENT OF METALS AND PLASTICS	
12 01	Wastes From Shaping and Physical And Mechanical Surface Treatment of Metals And Plastics	
12 01 06*	Mineral-based machining oils containing halogens (except emulsions and solutions)	A
12 01 07*	Mineral-based machining oils free of halogens (except emulsions and solutions)	A
12 01 08*	Machining emulsions and solutions containing halogens	A
12 01 09*	Machining emulsions and solutions free of halogens	A
12 01 10*	Synthetic machining oils	A
12 01 12*	Spent waxes and fats	A
12 01 14*	Machining sludge containing dangerous substances	M
12 01 16*	Waste blasting material containing dangerous substances	M
12 01 18*	Metal sludge (grinding, honing and lapping sludge) containing oil	M
12 01 19*	Readily biodegradable machining oil	A
12 01 20*	Spent grinding bodies and grinding materials containing dangerous substances	M
12 03	Wastes from Water and Steam Degreasing Processes (except 11)	
12 03 01*	Aqueous washing liquids	A
12 03 02*	Steam degreasing wastes	A
13	OIL WASTES AND WASTES OF LIQUID FUELS (except edible oils, and those in chapters 05, 12 and 19)	
13 01	Waste Hydraulic Oils	

13 01 01*	Hydraulic oils, containing PCBs (2)	A
13 01 04*	Chlorinated emulsions	A
13 01 05*	Non-chlorinated emulsions	A
13 01 09*	Mineral-based chlorinated hydraulic oils	A
13 01 10*	Mineral-based non-chlorinated hydraulic oils	A
13 01 11*	Synthetic hydraulic oils	A
13 01 12*	Readily biodegradable hydraulic oils	A
13 01 13*	Other hydraulic oils	A
13 02	Waste Engine, Gear and Lubricating Oils	
13 02 04*	Mineral-based chlorinated engine, gear and lubricating oils	A
13 02 05*	Mineral-based non-chlorinated engine, gear and lubricating oils	A
13 02 06*	Synthetic engine, gear and lubricating oils	A
13 02 07*	Readily biodegradable engine, gear and lubricating oils	A
13 02 08*	Other engine, gear and lubricating oils	A
13 03	Waste Insulating and Heat Transmission Oils	
13 03 01*	Insulating or heat transmission oils containing PCBs	A
13 03 06*	Mineral-based chlorinated insulating and heat transmission oils other than those mentioned in 13 03 01	A
13 03 07*	Mineral-based non-chlorinated insulating and heat transmission oils	A
13 03 08*	Synthetic insulating and heat transmission oils	A
13 03 09*	Readily biodegradable insulating and heat transmission oils	A
13 03 10*	Other insulating and heat transmission oils	A
13 04	Bilge Oils	
13 04 01*	Bilge oils from inland navigation	A
13 04 02*	Bilge oils from jetty sewers	A
13 04 03*	Bilge oils from other navigation	A
13 05	Oil/Water Separator Contents	
13 05 01*	Solids from grit chambers and oil/water separators	A
13 05 02*	Sludge from oil/water separators	A
13 05 03*	Interceptor sludge	A
13 05 06*	Oil from oil/water separators	A
13 05 07*	Oily water from oil/water separators	A
13 05 08*	Mixtures of wastes from grit chambers and oil/water separators	A
13 07	Wastes of Liquid Fuels	
13 07 01*	Fuel oil and diesel	A
13 07 02*	Petrol	A
13 07 03*	Other fuels (including mixtures)	A
13 08	Oil Wastes Not Otherwise Specified	
13 08 01*	Desalted sludge or emulsions	A
13 08 02*	Other emulsions	A
14	WASTE ORGANIC SOLVENTS, REFRIGERANTS AND PROPELLANTS (except 07 and 08)	
14 06	Waste Organic Solvents, Refrigerants and Foam/Aerosol Propellants	
14 06 01*	Chlorofluorocarbons, HCFC, HFC	A
14 06 02*	Other halogenated solvents and solvent mixtures	A
14 06 03*	Other solvents and solvent mixtures	A
14 06 04*	Sludge or solid wastes containing halogenated solvents	A

14 06 05*	Sludge or solid wastes containing other solvents	A
15	WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED	
15 01	Packaging (Including Separately Collected Municipal Packaging Waste)	
15 01 10*	Packaging containing residues of or contaminated by dangerous substances	A
15 01 11*	Metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers	A
15 02	Absorbents, Filter Materials, Wiping Cloths and Protective Clothing	
15 02 02*	Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	M
16	WASTES NOT OTHERWISE SPECIFIED IN THE LIST	
16 01	End-of-Life Vehicles from Different Means of Transport (Including Off-Road Machinery) and Wastes from Dismantling of End-of-Life Vehicles and Vehicle Maintenance (except 13, 14, 16 06 And 16 08)	
16 01 04*	End-of-life vehicles	A
16 01 07*	Oil filters	A
16 01 08*	Components containing mercury	M
16 01 09*	Components containing PCBs	M
16 01 10*	Explosive components (for example air bags)	A
16 01 11*	Brake pads containing asbestos	M
16 01 13*	Brake fluids	A
16 01 14*	Antifreeze fluids containing dangerous substances	M
16 01 21*	Hazardous components other than those mentioned in 16 01 07 to 16 01 11 and 16 01 13 and 16 01 14	M
16 02	Wastes from Electrical and Electronic Equipment	
16 02 09*	Transformers and capacitors containing PCBs	A
16 02 10*	Discarded equipment containing or contaminated by PCBs other than those mentioned in 16 02 09	A
16 02 11*	Discarded equipment containing chlorofluorocarbons, HCFC, HFC	A
16 02 12*	Discarded equipment containing free asbestos	A
16 02 13*	Discarded equipment containing hazardous components ⁽³⁾ other than those mentioned in 16 02 09 to 16 02 12	A
16 02 15*	Hazardous components removed from discarded equipment	A
16 03	Off-Specification Batches and Unused Products	
16 03 03*	Inorganic wastes containing dangerous substances	M
16 03 05*	Organic wastes containing dangerous substances	M
16 04	Waste Explosives	
16 04 01*	Waste ammunition	A
16 04 02*	Fireworks wastes	A
16 04 03*	Other waste explosives	A
16 05	Gases in Pressure Containers and Discarded Chemicals	

16 05 04*	Gases in pressure containers (including halons) containing dangerous substances	M
16 05 06*	Laboratory chemicals, consisting of or containing dangerous substances, including mixtures of laboratory chemicals	M
16 05 07*	Discarded inorganic chemicals consisting of or containing dangerous substances	M
16 05 08*	Discarded organic chemicals consisting of or containing dangerous substances	M
16 06	Batteries and Accumulators	
16 06 01*	Lead batteries	A
16 06 02*	Ni-Cd batteries	A
16 06 03*	Mercury-containing batteries	A
16 06 06*	Separately collected electrolyte from batteries and accumulators	A
16 07	Wastes from Transport Tank, Storage Tank and Barrel Cleaning (except 05 and 13)	
16 07 08*	Wastes containing oil	M
16 07 09*	Wastes containing other dangerous substances	M
16 08	Spent Catalysts	
16 08 02*	Spent catalysts containing dangerous transition metals ⁽⁴⁾ or dangerous transition metal compounds	M
16 08 05*	Spent catalysts containing phosphoric acid	M
16 08 06*	Spent liquids used as catalysts	A
16 08 07*	Spent catalysts contaminated with dangerous substances	M
16 09	Oxidising Substances	
16 09 01*	Permanganates (for example potassium permanganate)	A
16 09 02*	Chromates (for example potassium chromate, potassium or sodium dichromate)	A
16 09 03*	Peroxides (for example hydrogen peroxide)	A
16 09 04*	Oxidising substances, not otherwise specified	A
16 10	Aqueous Liquid Wastes Destined for Off-Site Treatment	
16 10 01*	Aqueous liquid wastes containing dangerous substances	M
16 10 03*	Aqueous concentrates containing dangerous substances	M
16 11	Waste Linings and Refractories	
16 11 01*	Carbon-based linings and refractories from metallurgical processes containing dangerous substances	M
16 11 03*	Other linings and refractories from metallurgical processes containing dangerous substances	M
16 11 05*	Linings and refractories from non-metallurgical processes containing dangerous substances	M
17	CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)	
17 01	Concrete, Bricks, Tiles and Ceramics	
17 01 06*	Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances	M
17 02	Wood, Glass and Plastic	
17 02 04*	Glass, plastic and wood containing or contaminated with dangerous substances	A
17 03	Bituminous Mixtures, Coal Tar and Tarred Products	
17 03 01*	Bituminous mixtures containing coal tar	M

17 03 03*	Coal tar and tarred products	A
17 04	Metals (Including Their Alloys)	
17 04 09*	Metal waste contaminated with dangerous substances	M
17 04 10*	Cables containing oil, coal tar and other dangerous substances	
17 05	Soil (Including Excavated Soil from Contaminated Sites), Stones and Dredging Spoil	
17 05 03*	Soil and stones containing dangerous substances	M
17 05 05*	Dredging spoil containing dangerous substances	M
17 05 07*	Track ballast containing dangerous substances	M
17 06	Insulation Materials and Asbestos-Containing Construction Materials	
17 06 01*	Insulation materials containing asbestos	M
17 06 03*	Other insulation materials consisting of or containing dangerous substances	M
17 06 05*	Construction materials containing asbestos	M
17 08	Gypsum-Based Construction Material	
17 08 01*	Gypsum-based construction materials contaminated with dangerous substances	M
17 09	Other Construction and Demolition Waste	
17 09 01*	Construction and demolition wastes containing mercury	M
17 09 02*	Construction and demolition wastes containing PCB (for example PCB -containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB -containing capacitors)	M
17 09 03*	Other construction and demolition wastes (including mixed wastes) containing dangerous substances	M
18	WASTES FROM HUMAN OR ANIMAL HEALTH CARE AND/OR RELATED RESEARCH (except kitchen and restaurant wastes not arising from immediate health care)	
18 01	Wastes from Natal Care, Diagnosis, Treatment or Prevention of Disease in Humans	
18 01 03*	Wastes whose collection and disposal is subject to special requirements in order to prevent infection	A
18 01 06*	Chemicals consisting of or containing dangerous substances	M
18 01 08*	Cytotoxic and cytostatic medicines	A
18 01 10*	Amalgam waste from dental care	A
18 02	Wastes from Research, Diagnosis, Treatment or Prevention of Disease Involving Animals	
18 02 02*	Wastes whose collection and disposal is subject to special requirements in order to prevent infection	A
18 02 05*	Chemicals consisting of or containing dangerous substances	M
18 02 07*	cytotoxic and cytostatic medicines	A
19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE	
19 01	Wastes from Incineration or Pyrolysis of Waste	
19 01 05*	Filter cake from gas treatment	A

19 01 06*	Aqueous liquid wastes from gas treatment and other aqueous liquid wastes	A
19 01 07*	Solid wastes from gas treatment	A
19 01 10*	Spent activated carbon from flue-gas treatment	A
19 01 11*	Bottom ash and slag containing dangerous substances	M
19 01 13*	Fly ash containing dangerous substances	M
19 01 15*	Boiler dust containing dangerous substances	M
19 01 17*	Pyrolysis wastes containing dangerous substances	M
19 02	Wastes from Physico/Chemical Treatments of Waste (Including Dechromatation, Decyanidation, Neutralisation)	
19 02 04*	Premixed wastes composed of at least one hazardous waste	A
19 02 05*	Sludge from physico/chemical treatment containing dangerous substances	M
19 02 07*	Oil and concentrates from separation	A
19 02 08*	Liquid combustible wastes containing dangerous substances	M
19 02 09*	Solid combustible wastes containing dangerous substances	M
19 02 11*	Other wastes containing dangerous substances	M
19 03	Stabilized/Solidified Wastes ⁽⁵⁾	
19 03 04*	Wastes marked as hazardous, partly ⁽⁶⁾ stabilized	A
19 03 06*	Wastes marked as hazardous, solidified	A
19 04	Vitrified Waste and Wastes from Vitrification	
19 04 02*	Fly ash and other flue-gas treatment wastes	A
19 04 03*	Non-vitrified solid phase	A
19 07	Landfill Leachate	
19 07 02*	Landfill leachate containing dangerous substances	M
19 08	Wastes from Waste Water Treatment Plants Not Otherwise Specified	
19 08 06*	Saturated or spent ion exchange resins	A
19 08 07*	Solutions and sludges from regeneration of ion exchangers	A
19 08 08*	Membrane system waste containing heavy metals	M
19 08 10*	Grease and oil mixture from oil/water separation other than those mentioned in 19 08 09	A
19 08 11*	Sludges containing dangerous substances from biological treatment of industrial waste water	M
19 08 13*	Sludges containing dangerous substances from other treatment of industrial waste water	M
19 10	Wastes from Shredding of Metal-Containing Wastes	
19 10 03*	Fluff-light fraction and dust containing dangerous substances	M
19 10 05*	Other fractions containing dangerous substances	M
19 11	Wastes from Oil Regeneration	
19 11 01*	spent filter clays	A
19 11 02*	acid tars	A
19 11 03*	aqueous liquid wastes	A
19 11 04*	wastes from cleaning of fuel with bases	A
19 11 05*	sludges from on-site effluent treatment containing dangerous substances	M
19 11 07*	wastes from flue-gas cleaning	A

19 12	Wastes from The Mechanical Treatment of Waste (For Example Sorting, Crushing, Compacting, Pelletising) Not Otherwise Specified	
19 12 06*	Wood containing dangerous substances	M
19 12 11*	Other wastes (including mixtures of materials) from mechanical treatment of waste containing dangerous substances	M
19 13	Wastes from Soil and Groundwater Remediation	
19 13 01*	Solid wastes from soil remediation containing dangerous substances	M
19 13 03*	Sludges from soil remediation containing dangerous substances	M
19 13 05*	Sludges from groundwater remediation containing dangerous substances	M
19 13 07*	Aqueous liquid wastes and aqueous concentrates from groundwater remediation containing dangerous substances	M
20	MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	
20 01	Separately Collected Fractions (except 15 01)	
20 01 13*	Solvents	A
20 01 14*	Acids	A
20 01 15*	Alkalines	A
20 01 17*	Photochemicals	A
20 01 19*	Pesticides	A
20 01 21*	Fluorescent tubes and other mercury-containing waste	A
20 01 23*	Discarded equipment containing chlorofluorocarbons	A
20 01 26*	Oil and fat other than those mentioned in 20 01 25	A
20 01 27*	Paint, inks, adhesives and resins containing dangerous substances	M
20 01 29*	Detergents containing dangerous substances	M
20 01 31*	Cytotoxic and cytostatic medicines	A
20 01 33*	Batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	A
20 01 35*	Discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components ⁽⁷⁾	M
20 01 37*	Wood containing dangerous substances	M

⁽¹⁾If these waste is certificated about that they comply with technical criteria of TS EN ISO 17225-1 and they do not contain halogenated organic compounds, these wastes are considered biomass and, these waste are burned according to the Industrial Air Pollution Control Regulation.

⁽²⁾ It refers to Polychlorinated (PCBs); Polichlorinad (PCT), monomethyl-tetra-chloro-diphenyl methane, monomethyl-dichloro-diphenyl methane or monomethyl-dibromo-diphenylmethane and incase of more than 50 ppm, it refers to Polychlorinated (PCB), Polichlorinad (PCT), monomethyl-tetra-chloro-diphenyl methane, monomethyl-dichloro-diphenyl methane, or the mixture containing the monomethyl-dibromo-diphenyl methane.

⁽³⁾ Hazardous components arising from electrical and electronic equipment contain accumulators and batteries which are mentioned under 16 06 and, mercury switches, glasses of cathode ray tubes and other activated glasses, etc. which are marked as hazardous in waste list.

⁽⁴⁾ Transition metals in question are listed as scandium, vanadium, manganese, cobalt, copper, thorium, niobium, hafnium, tungsten, titanium, chrome, iron, nickel, zinc, zircon, molybdenum and

tantalum. If these metals or their components are classified as dangerous, said catalyst waste should be tackled as hazardous. The classification of hazardous substances indicates that which one of transition metals and compounds of transition metals are dangerous.

(⁵) Stabilization process alters hazardousness of components of waste and so it converts hazardous waste to non-hazardous waste. However, solidification process with the use of additives only alters physical structures (for example, it converts liquid to solid.). On the contrary, it does not alter chemical properties.

(⁶) At the end of the stabilization process, waste is accepted as partially stabilized in situation where hazardous components do not completely turn into harmless components and they could be released into the environment in short, medium and long terms.

(⁷) Hazardous components arising from electrical and electronic equipment contain accumulators and batteries which are mentioned under 16 06 and, mercury switches, glasses of cathode ray tubes and other activated glasses, etc. which are marked as hazardous in waste list [45].

CURRICULUM VITAE

Credentials

Name, Surname: Esra ATEŞ

Place of Birth: Sürmene/Trabzon

Marital Status: Single

E-mail: esra_ates89@hotmail.com.tr/esra_ates@artvin.edu.tr

Address: Çarşı Mahallesi, Kayabaşı Sokak No: 10/3, Merkez/Artvin

Education

High School: Hasan Sadri Yetmişbir Anatolian High School (2003-2007)

BSc: Department of Environmental Engineering in Middle East Technical University (2008-2013)

MSc: -

PhD: -

Foreign Languages

English (Upper), Italian (Elementary)

Work Experiences

Research Assistant at Artvin Çoruh University (2016-...)

Areas of Experiences

Intern in Laboratory of Drinking Water Treatment Plant of Trabzon Municipality (20-day internship period between June and July in 2011)

Intern in General Directorate of State Hydraulic Works, 22. Regional Directorate in Trabzon (20-day internship period between June and July in 2012)

Projects and Budgets

-

Publications

-

Oral and Poster Presentations

5th International Conference on Industrial and Hazardous Waste Management
27th-30th September, 2016, Crete/Greece.



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GRADUATE SCHOOL OF SCIENCE AND ENGINEERING
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Name Surname: **Esra ATEŞ**

Student No: **N13129790**

Department: **Environmental Engineering**

Program: **Masters with Thesis**

Status: Masters Ph.D. Integrated Ph.D.

ADVISOR APPROVAL

APPROVED.

Assoc. Prof. Selim L. SANIN

