Eolss Publishers Co. Ltd.,
Oxford, United Kingdom

Information on this title: www.eolss.net/eBooks

ISBN- 978-1-84826-167-9 (e-Book Adobe Reader)
ISBN- 978-1-84826-617-9 (Print (Color Edition))

British Library Cataloguing-in-Publication Data
A catalogue record of this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data
A catalog record of this publication is available from the library of Congress

Singapore

ENVIRONMENTAL STANDARDS CONCERNING INDUSTRIAL POLLUTION DISCHARGE

Xianghua WEN
Department of Environmental Science and Engineering, Tsinghua University, Beijing 100084, P. R. China

Keywords: industrial, pollution, standard, waste water, gas, solid waste, noise, odor

Contents

Summary

Industry contributes various pollutants to the environment. Standards concerning industrial discharge are a very important part of the environmental standards. The principles and functions to set environmental emission standards are described. Taking the standards of the United States of America as an example, the basic contents of the discharge standards for air, water, solid pollutants, odor and noise are introduced. The environmental management standards set by the International Standards Organization (ISO) are discussed. The development trends of the emission standards are summarized. It is predicted that environmental standards will soon be an integral part of the world's general-purpose, distributed, electronically-linked information system that provides access to essentially all human knowledge.

1. Introduction

Industry is a major contributor to pollution. Therefore, the establishment and enforcement of environmental standards for industrial discharge is very important to protect the environment.

Environmental standards are norms of governmental or non-governmental agencies and institutions. They include many "discussion values" or "orientation values" that are suggested by scientists, committees, commissions, associations, or agencies. "Guidelines" are made available to the public by agencies, commissions, and associations. "Limits" are mandatory and set by regulatory agencies following legislative action.

The pollutant discharge standards are the main body of the environmental standards Industrial pollution discharge standards are mainly emission-based standards, which are norms to limit the emissions of contaminants into environmental media (water, air, and soil) as well as for the disposal of benign wastes.

The environmental standards are composed of a very complex system. Different countries, different regions set their environmental standards based upon different principles. The common principles cover the following

- Protection human health and maintenance of ecological balance. The World Health Organization (WHO) sets a series of pollutant criteria upon summarizing the data from all around the world. These criteria provide the very basic base for countries worldwide to develop their environmental standards.
- Economic acceptability. The current economic capability should afford the expense to meet the standards.
- Integrated consideration of regional conditions, short term and long term planning, policy requirements.
- Sound scientific support Advanced analysis, monitoring, sampling methods should be used. The best available technology (BAT) and advanced scientific tools should be evaluated to establish environmental standards.

Generally speaking, industrial discharge standards are made based upon comprehensive considerations of the technology, economics, and environmental characteristics. It is a measurement to realize the environmental quality standards. For industrial pollution, the discharge standards have various categories depending on various industries, the pollutant exiting type, characteristics, time, scale, etc.

In this chapter, we take the standard system of the USA as an example to introduce some basic parts of the emission standards.

2. Emission Standards for Air

The Clean Air Act (CAA) is a comprehensive federal statute designed to regulate air emissions from stationary and mobile sources. The goal of the CAA is to protect the public health and welfare from the harmful effects of air pollutants. To this end, national ambient air quality standards were required to manage and regulate the provisions of the act, including permits. For implementing the CAA, the U. S. Environmental Protection Agency (EPA) established a series of regulations, including National primary and secondary ambient quality standards; Standards of performance for new stationary sources; National emission standards for hazardous air pollutants; National emission standards for hazardous air pollutants for source categories; etc.

2.1. Ambient Air Quality Standards

Ambient air quality standards are national in scope and set air quality goals to be achieved by the states. The standards are stated in terms of annual concentration levels or annual mean measurement for the air. These numerical standards were to be based on background studies that included control technology, costs, energy requirements, emission reduction benefits, and environmental impacts.

Based on the criteria established for each pollutant under the CAA and "allowing an adequate margin of safety", EPA is directed to promulgate national primary and secondary ambient air quality standards for each pollutant. Primary air quality standards are designed to protect the public health. Secondary standards are intended to protect the public welfare from any known or anticipated adverse effects associated with the presence of such pollutants in the air. The major criteria pollutants are: carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM_{10}, particulate matter that is 10 microns or less in diameter and $PM_{2.5}$, particulate matter that is 2.5 microns or less in diameter), ozone, lead.

Regions within a state are designated as either attainment or non-attainment areas. When the air quality exceeds national ambient air quality standards, the region is an "attainment area". Non-attainment areas are quality control regions that have not met the ambient air quality standards. The designations are pollutant-specific, which means an area may fall into both categories for different pollutants. EPA allows new major source in non-attainment areas only if stringent conditions are met, including a greater than one-for–one offset of emissions from existing sources in the area. National air quality regulations are applied to individual sources through State Implementation Plans (SIPs). A SIP is an extensive, detailed document that contains elements such as emission inventories, monitoring programs, attainment plans and enforcement programs.

2.2. Structure of the Emission Standards

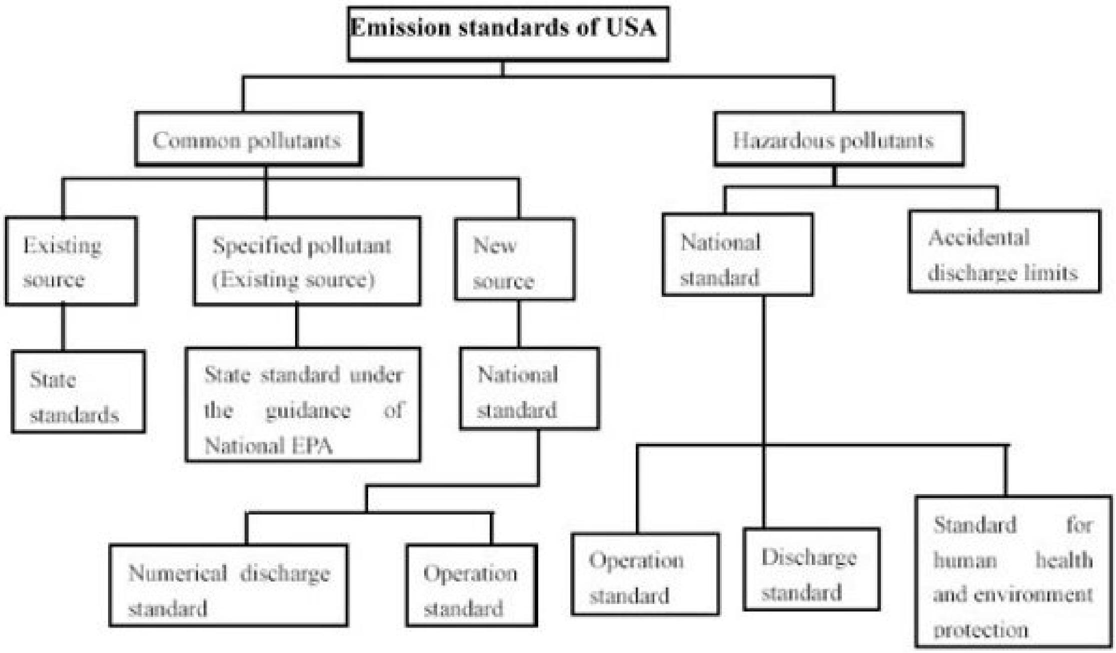

Figure 1: Structure of the emission standards for air pollutants in the USA

There are standards for common pollutant and hazardous pollutants. The permitting limits for pollutants for new source and existing source are different. Figure 1 describes the structure of the emission standards for air pollutants in the USA.

2.3. New Source Performance Standards

Performance standards for new sources are designed to allow industrial growth without undermining the national program for achieving air quality goals. New Source Performance Standards (NSPS) are established at the national level in order to prevent states from becoming "pollution havens" and attracting industry with their lenient emission standards. NSPA are oriented to particular sources of pollutants rather than to air quality in general. NSPS are typically numeric standards that relate to the level of pollution control achieved by installing the best demonstrated technology (BDT).

The new source performance standards are set for specific processes and apply to all new processes of that type and to existing sources that are substantially modified or rebuilt. The regulations also specify test standards that apply nationwide. On the state level, existing facilities must meet a state-promulgated standard pursuant to requirements of the CAA.

	Source
	General provisions
	Adoption and submittal of state plans for designated facilities
	Emissions guidelines and compliance times
	Emissions guidelines and compliance schedules for municipal waste combustors
	Emissions guidelines and compliance schedules for municipal waste landfills
	Emissions guidelines and compliance schedules for sulfuric acid production units
	Fossil-fuel fired steam generators (construction commenced after 8-17-71)
	Electric utility steam generating units (construction commenced after 9-18-78)
	Industrial –commercial-institutional steam generating units
	Small industrial-commercial-institutional steam generating units
	Incinerators
	Municipal waste combustors (construction between 12-20-89 and 1-20-94)
	Portland cement plant
	Nitric acid plants
	Sulfuric acid plants
	Asphalt concrete plants
	Petroleum refineries
	Storage vessels for petroleum liquids (construction commenced after 6-11-73 and prior to 5-19-78)
	Storage vessels for petroleum liquids (construction commenced after 5-19-78 and prior to 7-23-84)
	Volatile organic liquid storage vessels (construction commenced after 7-23-84)

	Secondary lead smelters
	Secondary brass and bronze ingot production plants
	Primary emissions from basic oxygen process furnaces (construction commence after 6-11-73)
	Secondary emissions from basic oxygen process furnaces (construction commenced after 1-20-83)
	Sewage treatment plants
	Primary copper smelters
	Primary zinc smelters
	Primary lead smelters
	Primary aluminum reduction plants
	Phosphate fertilizer industry: wet-process phosphoric acid plants
	Phosphate fertilizer industry: super phosphoric acid plants
	Phosphate fertilizer industry: diammonium phosphate plants
	Phosphate fertilizer industry: triple super phosphate plants
	Phosphate fertilizer industry: Granular triple super phosphate storage facilities
	Coal preparation plants
	Ferroalloy production facilities
	Steel plants: electric arc furnaces
	Steel plants: electric arc furnaces and argon-oxygen decarbonization vessels (constructed after 8-1 7-83)
	Kraft pulp mills
	Glass manufacturing plants
	Grain elevators
	Surface coating of metal furniture
	Stationary gas turbines
	Lime manufacturing plants
	Lead-acid battery manufacturing plants
	Metallic mineral processing plants

Table 1: Standards of performance for new stationary sources

Pollutant	
Sulfur dioxide	Total fluorides
Particulate matter(TSP)	Total reduced sulfur
Particulate matter(PM_{10})	Reduced sulfur compounds
Nitrogen oxides	Hydrogen sulfide
Carbon monoxide	Asbestos
Volatile organic compounds(ozone)	Beryllium
Lead	Mercury
Sulfuric acid mist	Vinyl chloride

Table 2: New source review (NSR) pollutants

Table 1 lists the standards of performance for new stationary sources. For different sources there are different numerical discharge standards and operation standards. For some types of sources, which built up at different time periods, there are different standards.

The list of federally regulated criteria pollutants that must be estimated in the emissions inventory are summarized in Table 2.

2.4. Hazardous Air Pollutants

The 1990 Amendments of CAA established an initial list of 189 hazardous air pollutants (HAPs) and give EPA the authority to periodically review and add HAPs to the list. EPA is also required under the amendments to promulgate technology-based limitation for industrial source categories and issue standards for each category. It is estimated that as many as 250 categories will be established with major sources subject to maximum achievable control technology (MACT) limitations that are determined by EPA.

National emission standards for hazardous air pollutants apply to new and existing sources. The selected pollutants are those which may cause or contribute to increased mortality or an increase in serious irreversible or incapacitating reversible illness.

Table 3 identifies common HAPs. An emission inventory should include known HAP emissions as well as criteria pollutants. It is important to note that state and local laws may regulate pollutants that are not on the federal lists.

Asbestos	Mercury compounds
Cadmium compounds	Methanol
Chlorine	Nickel compounds
Chloroform	Pentachlorophenol
Chromium compounds	Phosphorous
Cyanide compounds	Radio nuclides
Formaldehyde	Selenium compounds
Hydrochloric acid	Toluene
Lead compound	Xylenes
Manganese compounds	

Table 3: Common hazardous air pollutant

2.5. National Emission Standards for Air Pollutants

Some specific criteria pollutants relating to particular industries are regulated through the creation of federal New Source Performance Standards (NSPS). A relatively new group of national emission standards are being developed for hazardous air pollutants. EPA is in the process of promulgating Maximum Achievable Control Technology (MACT) standards for a long list of hazardous air pollutants.

Early air pollution laws focused on controlling the so-called criteria pollutants. As knowledge of, and concern about, chemical substances that may be health hazards (carcinogenic or other wise) increased, laws were developed to control the emission of hazardous air pollutants, or "air toxicants". The federal standards governing these emissions, known as the "National Emissions Standards for Hazardous Air Pollutants (HESHAP), were completely overhauled by Title III of the CAA Amendments of 1990

2.6. MACT Determinations (how to determine the emission limitations for HAPs)

MACT is defined in the regulations as " the emission limitation which is not less stringent than the emission limitation achieved in practice by the best controlled similar source, and which reflects the maximum degree of reduction in emissions of HAPs (including prohibition of emissions) that the permitting authority, taking into consideration the cost of achieving such emission reduction and any non-air quality health and environmental impacts and energy requirements, determined achievable by the constructed or reconstructed major source" In determining which emission limitation is best, EPA evaluates both the existing sources and new sources. For existing sources, the MACT "floor" is determined by the average emission limitation achieved by the best performance 12% of the existing U. S sources. If fewer than 30 sources exist, the performance of the best 5 sources is averaged. In practice, many sources have limited data or no data on the HAP emissions EPA is required to evaluate. Consequently, industry groups have joined EPA to develop the scientific emissions data required to perform the MACT evaluation. For some HAPs, test methods do not exist, and until they are developed, EPA will not be able to evaluate MACT unless a surrogate pollutant is designated. In the case of new sources, MACT will be equal to the best emission limitation achieved in practice by a similar source. Obviously, this limitation will become more stringent over time as control technology improves.

3. Wastewater Emission Standards

The Clean Water Act (CWA) enacted in 1948. Major amendments were in 1956, 1972, 1977 and 1987. The purpose of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters" with the goal of attaining "fishable and swimmable" water conditions whenever possible.

3.1. Water Quality Standards

Water quality standards for a particular body of water consist of a designated use and criteria for various pollutants, expressed in numerical concentration limits necessary to support the use. Section 303 of the CWA requires every state to establish, and every three years to review, water quality standards for stream segments within the state.

Water quality standards serve as the basis not only for imposing effluent limitations on point source dischargers, but also for establishing controls for non-point source underwater management plans.

3.2. Water Discharge Permits

The keystone of the CWA is the National Pollutant Discharge Elimination System (NPDES) permit program, which regulates the discharge of pollutants into surface waters. Permit discharge limits are based on both available pollution control technology and the ability of the receiving stream to assimilate the discharged pollutants. Then, there are technology-based standards and water quality-based standards.

Permits for industrial effluents are subject to state and/or federal requirements. In particular, many industrial categories are covered by federal effluent guidelines and standards.

Table.4 lists part of the industrial categories for which limitations and guidelines were set for their effluent.

	Aluminum forming
	Asbestos manufacturing
	Battery manufacturing
	Builders' paper and board mills
	Centralized waste treatment
	Coal mining
	Coil coating
	Copper forming
	Electrical and electronic components
	Electroplating
	Explosives manufacturing
	Ferroalloy manufacturing
	Fertilizer manufacturing
	Glass manufacturing
	Ink formulating
	Inorganic chemicals
	Iron and steel manufacturing
	Leather tanning and finishing
	Low BTU gasification
	Meat products
	Metal finishing
	Metal molding and casting (foundries)
	Mineral mining and processing
	Nonferrous metals forming and metal powders
	Nonferrous metals manufacturing
	Oil and gas extraction
	Ore mining and dressing
	Organic chemicals, plastics and synthetic fibers
	Paint formulating
	Paving and roofing materials (tars and asphalts)
	Pesticide chemicals
	Petroleum refining
	pH effluent limitation under continuous

	monitoring
	Pharmaceutical manufacturing
	Plastics molding and forming
	Polychlorinated biphenyls
	Porcelain enameling
	Pulp, paper, and paperboard
	Rubber manufacturing
	Seafood processing
	Shipbuilding industry
	Soap and detergent manufacturing
	Steam electric power generating
	Sugar processing
	Textile mills
	Timber products processing
	Water supply

Table 4: Industrial categories that have specified effluent standard

3.2.1. National Pollutant Discharge Elimination System (NPDES) Permits

Most industrial facilities have some type of wastewater discharge. Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES). The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

NPDES permits include specific effluent limitations for each pollutant discharged by a facility. It also contains several pages of "general conditions" that apply to the permit.

3.2.2. Technology-Based Effluent Standards

The key provisions of any NPDES permit are the effluent limitations, which specify how much pollution may be discharged by a facility. In developing the technology-based effluent limitations or guidelines, EPA divided the universe of point source discharges into industrial categories and subcategories. EPA then established effluent limitations for specific pollutants in the various categories and sub categories, based on the pollution control technologies available in the industry. In the absence of technology-based effluent limitations, permitting authorities may establish limitations through a case-by-case technology review, referred to as Best Engineering Judgment (BEJ).

Effluent standards are based upon the maximum concentration of a pollutant (mg/L) or the maximum load (kg/d). These effluent guideline criteria (expressed as kilogram pollutant per unit of production) have been developed for each industrial category to be met within specified time periods.

The CWA mandates that technology-based effluent limitations for existing sources should be based on the following three categories of technology review:

- Best Practicable Control Technology Currently Available (BPT). The BPT technology level is intended to represent the average of the best existing performance of facilities of various ages, sizes, and processes within the relevant point source category and applied to all point source discharges as of July 1, 1977.
- Best Conventional Pollution Control Technology (BCT) for certain conventional pollutants, such as biochemical oxygen demand, total suspended solids, fecal coliform, oil, and grease, and for pH. BCT limits were to be achieved by July 1, 1984.
- Best Available Technology Economically Achievable (BAT) for all toxic pollutants. EPA has published a list of 65 so-called "priority pollutants" which are or may be toxic. BAT limits were established for all "non-conventional pollutants", which are those pollutants that have not been designated by EPA as either "toxic" or "conventional". BAT limits must have be met by March 31, 1989.

In general, effluent guidelines are developed by considering an exemplary plant in a specific industrial category and multiplying the wastewater flow per unit production by the effluent quality attainable from the specified BPT process to obtain the effluent limitation in pounds or kilograms per unit of production. The effluent limitations consider both a maximum 30-day average and a 1-day maximum level. In general, the daily maximum is 2 to 3 times the 30-day average.

EPA has also established effluent limitations for new sources, referred to as New Source Performance Standards (NSPS), based on the Best Available Demonstrated Control Technology (BDCT). The rationale for this stringent technology standard for new sources is that new sources should be required to implement the best and most current wastewater technologies before they are allowed to operate.

3.2.3. Water-Quality-Based Effluent Standards

If the technology-based effluent limitations are insufficient to meet water quality standards in a receiving stream, the CWA authorizes the imposition of more stringent "water quality-based" effluent limits. Under the law, water quality-based limits can be more restrictive than those based on technology.

Major revisions were made to the CWA in 1987 concerning situations where state water quality standards and/or technology-based effluent limitations have not reduced toxic pollutant concentrations to acceptable levels. First, states must identify waters that, after the application of technology-based effluent limitation and categorical pretreatment standards, cannot attain or maintain either state water quality standards or a level of water quality that protects human health and the environment. Next, individual control strategies (ICSs) must be developed for each identified point source that is contributing to the failure to meet the water quality standard. Effluent limitations are then established, based on the individual control strategies.

3.2.4. The Total Maximum Daily Loads

Water bodies in which the designated uses are being negatively impacted by excessive pollutant loadings are listed as "water quality limited" stream segments. States must develop total maximum daily loads (TMDLs) at whatever levels are necessary to achieve the applicable water quality standards.

The TMDL is the total amount of particular pollutants or parameters such as temperature that sources can discharge into a receiving stream without violating water quality standards. The TMDL is essentially that of determining the capacity of each stream segment to assimilate pollutant dischargers. A simple formula for TMDLs is provided as follows:

TMDL = non-point source pollution + background + point source waste load allocation + margin of safety

The margin of safety accounts for the uncertainty of calculating pollutant loads and the estimated capacity of the receiving water body. Given the subjective nature of this concept, the margin of safety calculation is closely scrutinized by all parties interested in the TMDL process. The TMDL process is difficult, inexact and controversial. Establish TMDLs can take from a few weeks to several years to complete.

3.2.5. Toxic Pollutants

Special emphasis is placed on the control of an effluent containing toxic pollutants. EPA has listed a long list of pollutants that have been designated as toxic. Effluent standards have been promulgated for some toxic pollutants. These are highlighted in Table 5.

Toxic pollutant	Source	Effluent limitation
Aldrin/dieldrin	Manufacturer	Prohibited
	Formulator	Prohibited
DDT	Manufacturer	Prohibited
	Formulator	Prohibited
Edrin	Manufacturer	
	Existing	1.5 μg/L [a]
		0.0006 kg/KKg [b]
		7.5μg/L [c]
	New	0.1μg/L [a]
		0.00004 kg/KKg [b]
		0.5μg/L [c]
	Formulator	Prohibited
Toxaphene	Manufacturer	
	Existing	1.5 μg/L [a]
		0.00003 kg/KKg [b]

		7.5μg/L [c]
	New	0.1μg/L [a]
		0.000002 kg/KKg [b]
		0.5
	Formulator	Prohibited
Benzidine	Manufacturer	10μg/L [a]
	Existing and New	0.130 kg/KKg [b]
		50μg/L [c]
	Applicator	10μg/L [a]
	Existing and New	25μg/L [c]
Polychlorinated Biphenls (PCBs)	Electrical Capacitor manufacturer	
	Electrical transformer manufacturer	

a. An average per working day, calculated over any calendar month.
b. Monthly average daily loading per quantity of pollutant produced.
c. A sample(s) representing any working day.

Table 5: Toxic pollutant effluent standards

3.3. Industrial Discharges into Public Owned Treatment Works

Industrial facilities often discharge their wastewater into a publicly owned treatment works (POTW), which are commonly referred to as indirect dischargers. POTWs are usually operated by cities or local sewerage agencies. Dischargers to POTW are typically required to treat their effluent prior to discharge, as provided by the terms of the "pretreatment permit" issued to the discharger by the POTW.

POTW must enforce narrative standards, numerical criteria, and categorical standards that EPA has developed to regulate indirect discharges. The PTOW may also develop and enforce its own discharge limitations, commonly referred to as "local limits." The POTW must issue individual discharge permits to all "significant Industrial Users" in a timely manner. Most industrial facilities that discharge to POTW will be considered Significant Industrial Users and, therefore, require a pretreatment permit. Industrial user permits usually contain effluent limitations, monitoring and report in requirement, and special and general conditions violators of industrial user permits can be assessed for civil and /or criminal penalties.

EPA is authorized to establish pretreatment standards applicable to certain indirect dischargers for controlling pollutants determined not to be susceptible to treatment by a POTW or that would interfere with the operation of the treatment works. Indirect dischargers subject to pretreatment standards may not discharge effluents into a POTW unless they comply with such standards.

In general, compatible pollutants, such as biological chemical demand (BOD), suspended solids (SS), and coliform organisms can be discharged if the municipal plant has the capability of treating these wastewaters to a satisfactory level. Non-compatible pollutants, such as grease and oil and heavy metals, must be pretreated to specified levels. Rigid limitations have been developed for the discharge of toxic substances into the nation's water ways.

4. Solid and Hazardous Waste Management

Solid and hazardous waste management is an aspect of environmental protection that has received relatively little federal attention until the late 1970s. Comprehensive federal regulation of solid waste management began with the enactment of the Resource Conservation and Recovery Act of 1976(RCRA), which amended the Solid Waste Disposal Act. In general terms, RCRA establishes procedures for the management, reuse, or recovery of solid waste and imposes detailed requirements governing the highly regulated subcategory of solid waste determined to be "hazardous".

4.1. State Solid Waste Management

State solid waste policies strongly encourage waste reduction, reuse, recycling, and energy recovery. Only waste that cannot be reduced, reused, or recovered should be disposed of in landfills or other facilities.

State solid waste management statutes and regulations typically have established requirements for permitting solid waste disposal sites. Sitting a new land fill involves analyzing the scientific, logistical, and societal factors associated with each alternative location and can be a costly and time consuming process. Requirements imposed by solid waste disposal site operating permits include the following:

- Use of "best management practices" to prevent contamination of the surrounding environment;
- Groundwater monitoring and corrective action if necessary;
- Recycling procedures;
- Vector and bird control;
- Quarterly reporting;
- Gas emissions monitoring and control, and
- Closure and postclosure plans and financial assurance.

4.2. Federal Regulation of Hazardous Wastes

Managing hazardous waste is one of the most challenging aspects of environmental management. As required by RCRA, EPA has developed a "cradle–to–grave" regulatory scheme for managing hazardous wastes and controlling their ultimate disposal. EPA's RCRA program establishes standards for hazardous waste management applicable to hazardous waste generators, transporters, and treatment, storage, and disposal (TSD) facilities. The Hazardous waste regulations are considered by most experts to be the most complicated federal environmental regulatory program.

Under the hazardous waste regulations, a material must first fit the definition of a "solid waste" before it can be considered a hazardous waste. Solid waste is generally defined as a solid, liquid, or gas that is discarded material and is not expressly excluded from the definition of solid waste or granted a variance from its classification as a solid waste.

Once it is designated a hazardous wastes; it is specifically listed or it exhibits one of four hazardous characteristics, ignitability, corrosivity, reactivity, and /or, toxicity. There are three categories of listed hazardous waste:

- Hazardous wastes from nonspecific sources are generic wastes that may be generated by any number of industrial processes. An example of hazardous wastes from a nonspecific source are spent halogenated solvents used in degreasing, such as tetrachlorethylene, trichloroethylene, methylene chloride 1.1.1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons.
- Hazardous wastes from specific sources are hazardous wastes generated by processes in a particular industry. An example of hazardous wastes from a specific source is that of tank bottoms (Leaded) in the petroleum refining industry.
- Specified commercial chemical product wastes are wastes if and when they are discarded or intended to be discarded. It contains hundreds of chemical products identified either by trade or by chemical name. An example of these is pentachlorophenol.

4.3. Hazardous Waste Generator Categories and Permits for them

There are three categories of hazardous waste generators defined by EPA. The permits for them are different.

- Conditionally exempt small-quantity generator. If a facility does not generate more than 100 kg of hazardous waste in a month, the facility is defined as a "conditionally exempt" small-quantity generator and is not subject to many of the hazardous waste management and permitting requirements.
- 100-1000 kg/month small-quantity generator is required to comply with most of the hazardous waste management regulations applicable to generators.
- 1000 or more kg/month generator must comply with all of the hazardous waste management requirements applicable to generators.

4.4. Common Management Violations

Table 6 lists the common hazardous waste management violations.

(1)	Waste analysis
	Failure to conduct a waste stream determination
	Failure to use proper sampling or analytical methods
	Failure to use proper units of measures

(2)	Drum management
	Improper labeling
	No accumulation start date marked on the drum
	Insufficient aisle space between drums
	Failure to keep containers closed
(3)	Record keeping and reporting
	Failure to submit annual or biennial report
	Failure to use proper agency forms
	Failure to update contingency plan
	Failure to submit exception report for missing manifests
	Failure to keep waste manifests for three years
(4)	Inspections
	Failure to inspect emergency response equipment on a regular basis
	Failure to conduct equipment inspections
	Failure to document equipment inspections
	Failure to document corrections made to equipment

Table 6: Common hazardous waste management violations

5. Noise and Odors

Both noise and odor are highly subjective pollutions, familiarity tending to build up a natural tolerance. However, they can be of major concern to those living or working close to sources.

The Noise Control Act mandates the EPA to promulgate standards for noise emissions from the following new products: (1) Potable air compressors; (2) Medium- and heavy-duty trucks; (3) Earth-moving machinery; (3) Buses; (4) Truck-mounted solid waste compactors; (5) Motorcycles; (6) Jackhammers; (7) Lawn mowers. Because the noise pollution is very often a local community problem and needs to be regulated at the local level, with support from the state and national level in the form of grants and research results. There are already noise emission standards for (1) construction equipment; (2) Interstate motor vehicles; (3) Railroads; (4) portable air compressors; (5) Aircraft noise and sonic boom.

Odors are even more subjective, and until the 1980s the nose has been the most sensitive detector for many of the most disturbing smells, which have been assessed by panels of human "sniffers" exposed to a common source. Until the 1990s, there have been moves to develop reliable odor monitors using semi-conductor odor sensors. One such device provides a choice of 5 sensors, which can be used to fingerprint an odor, and then allow qualitative or quantitative assessments of change to be made, even of mixed odors.

6. ISO (International Standards Organization)

ISO is a federation of delegates for countries around the world that establishes standards designed to facilitate international trade by ensuring that materials, products, processes, and services meet certain minimum standards. Compliance with any standards developed by ISO is voluntary; however, it often happens that there is an intention to establish international standards for environmental management.

There may once have been a time when strict adherence to the legal requirement of these laws and regulations would suffice. That does not seem to be enough today, as the public expects companies to go beyond compliance in their environmental endeavors and to consider concepts such as "sustainability" and "life cycle analysis" The emergence of ISO standards for environmental management systems furthers these new concepts, including a requirement to evaluate the impact of a facility's operation on the environment.

In the future, the environmental performance of industrial facilities around the world will use the same set of standards, and the ability of companies to meet these standards may affect the acceptability of their products in the market-place. Many customers today ask for an "environmental certification" prior to purchasing a product. This suggests that programs such as Pollution Prevention and Life Cycle Assessment will become integral components of future environmental management systems.

6.1. ISO 14000

International environmental management systems are being developed that raise the environmental management of a facility beyond regulator compliance. "ISO 14000" is a shorthand phrase that refers to an emerging family of international environmental management standards. The ISO 14000 standards are being developed by one of the technical committees of the International Organization for Standardization (ISO).

6.2. ISO 14001

ISO 14001 was finalized in September 1996 and is now being implemented by companies throughout the world. ISO 14001 is designed to improve a company' environmental performance through the creation and implementation of an Environmental Management System (EMS). A companion standard, ISO 14004, provides guidance on developing and implementing an EMS and integrating the EMS into the overall management practices at the facility.

The purpose of ISO 14001 is to take a company beyond compliance. The major advantage of ISO 14001 is that it provides a widely accepted method of designing and implementing an environmental management system. Whether a company needs to ISO certify, its EMS is influenced by several major factors.

Companies that have an approved EMS are provided with a certificate that bears the name of the registrar and the accreditation body. The certificates are valid for a finite period of time, usually three years. The registrars conduct surveillance audits during the life of the certificate to ensure that the company continues to meet the ISO 14001 requirements.

Compliance with ISO 14001 or similar environmental management system standards will likely be required of most companies within the next decade. The reasons are:

First and probably most important, there likely will be strong market forces pushing companies to ISO 14001 certify. This trend will likely continue into the future.

Second, there may also be strong regulatory incentives to ISO certify environmental management systems. ISO 14000 concepts have already been evaluated by the Environmental Protection Agency(EPA) in connection with such programs as the Common Sense Initiative, and the Environmental Leadership Program.

Finally, many companies will consider ISO 14001 certification to be another way to demonstrate to the public that they are good corporate citizens. These pressures alone may be enough to persuade many companies to ISO certify.

7. Enforcement

All of the major federal environmental statutes contain provisions granting EPA broad authority to conduct regulatory inspections.

Environmental laws all provide for criminal penalties for individuals or companies who knowingly or willfully violate the requirements of the laws.

Repeat criminal offenders are subject to potentially longer prison terms and higher fines. Congress routinely stiffens the criminal penalty provisions of environmental statutes when they are reauthorized or rewritten. Several states have also passed their own statutes, which contain criminal liability provisions similar to those in federal law.

Traditionally, criminal prosecution for environmental violations was possible only if an individual knowingly or willfully violated the applicable legal requirements. However, this traditional approach to liability for environmental crimes is rapidly changing.

To encourage the prosecution of environmental crimes, Congress, in the Pollution Prosecution Act of 1990, required EPA to hire and train a significant number of additional criminal investigators. In response, the environmental Crime Unit of the Department of Justice increased its staff of prosecutors to handle a greater number of environmental criminal prosecutions.

8. Development Trend of Emission Standards

The need to have a safe and pollutant free environment is a widely discussed issue in our society today. Meanwhile, industries are developing fast to meet the requirements of a better human living level. The characteristics of industrial discharge sources become more complex. The toxic materials are produced everyday. In this situation, the improvement of environmental standards and their enforcement system is crucial.

The global marketplace and advances in information technologies are leading to great changes in standards. These include growing reliance on international standards, new standards-development techniques, and new media and environments in which standards are expressed.

Standards and standards-developing organizations are changing markedly as the new millennium approaches. Requirements for international competitiveness of products and services, environmental protection, conservation of resources, and public health and safety, place heavy demands on standards. Increased reliance is placed on international standards with the globalization of commerce and the development of the World Trade Organization. Public and private organizations based on national standardization must find roles in international standardization or wither away.

To carefully protect and improve the environmental quality, the standards are becoming more and more stringent. This is guaranteed by the advancement of technology. The detecting limits of advanced analyzers enhanced this considerably The treatment ability of new or renovated technology improved this as well. The wide awareness of environmental issues forces the implementation of more stringent environmental standards.

Traditionally, standards have been expressed by text, including words, figures tables and formulas, to guide the user in decision making. Standards available from general-purpose information systems will be capable of accessing and processing data to evaluate compliance with their provisions. Such standards will be convenient and efficient: input data will be accessed automatically from pertinent fields of the general and project-specific databases; results of evaluations will be recorded automatically in the project-specific database and used in decisions affecting design, construction or operation of industrial facilities. Major uses of standards will be associated with computer-aided systems and major revenues from uses of standards will accrue to systems developers and users. Standards-developing organizations should respond to this marketplace by themselves producing standards in the form of executable objects. Computer aids can assist in the formulation and expression of standards that are complete in coverage of the intended scope, consistent and unambiguous in their logic, and correct in reproducing the intent of the formulators.

In the near future, standards will be an integral part of the world's general-purpose, distributed, electronically-linked information system that provides access to essentially all human knowledge.

Glossary

ISO:	International Standards Organization
WHO:	World Health Organization
Environmental standards:	norms of governmental or non-governmental agencies and institutions.
EPA:	Environmental Protection Agency
CAA:	Clean Air Act
HAPs:	hazardous air pollutants

MACT:	maximum achievable control technology
NSPS:	New Source Performance Standards
CWA:	Clean Water Act
NPDES:	National Pollutant Discharge Elimination System
BPT:	Best Practicable Control Technology Currently Available
BCT:	Best Conventional Pollution Control Technology
BAT:	Best Available Technology Economically Achievable
TMDLs:	Total maximum daily loads
POTW:	Publicly owned treatment works
BOD:	Biological chemical demand
SS:	Suspended solids

Bibliography

Erickson S. L., Brian J. K. (1999) *Fundamentals of environmental Management.* John Wiley & Sons, Inc. [A comprehensive review of the fundamental concepts of environmental management as a guidance document]

Förstner U. (1995) *Integrated pollution control.* Translated and edited by Weissbach A. and Boeddicker H., Springer-Verlag Berlin Heidelberg. [Development and optimization of method that limit the spread of pollutants in human and natural environment]

Robert A. C. (1998) *Standard handbook of environmental engineering.* McGraw Hill. 2nd edition. [Introduction of environmental legislation]

Vincent O'malley. (1999) The integrated pollution prevention and control (IPPC) directive and its implications for the environment and industrial activities in Europe. *Sensors and Actuators* B. 59:78-82 [Holistic control of environmental pollution]

Wright R. N. (1999) Standards media and methods. *Automation in Construction*. 8: 473-479 [New trends in environmental standards development]

Biographical Sketch

Xianghua WEN is a Professor in Department of Environmental Science and Engineering at Tsinghua University, Beijing, Peoples' Republic of China. She received her Ph.D degree in Environmental Engineering from Tsinghua University in 1991. She teaches Modern Environmental Biotechnology for graduate students. She carries out the research works in the State Key Joint Laboratory of Environmental Simulation and Pollution Control. Her major research fields are in Water pollution control theory and technology and Environmental Chemistry. The on-going project that she is in responsible for or involved in include: "Membrane Bioreactor for Industry Wastewater Treatment"; "Effect and reinforced mechanism of modern biotechnology in detoxification of pollutants"; "Sustainable Development of Water Resource in Chinese Cities"; "Screening and testing on White-rot Fungi to degrade refractory organics" and etc. She is the author or co-author of about 100 technical papers and research reports.