CHAPTER 8

INDUSTRIAL EMISSIONS AND CONTROLS

Emissions of lead, together with other harmful or potentially hazardous substances, can occur at all stages of production, from mining of ore, during smelting and refining, and also, potentially, during the manufacture of the finished products. Lead emissions also occur from non-related industries, such as other metal works, incinerators and in, small amounts, from power stations. The quantities of emissions are declining in the Western World as environmental legislation reduces permitted releases, increasingly effective pollution abatement technologies are used, and industry moves gradually towards inherently cleaner, more efficient technologies. However, some emissions are inevitable, especially from older plants which process many thousands of tonnes of material per year. However, the requirement to use Best Available Techniques under forthcoming IPPC legislation will further reduce emissions from older plants.

The bulk of emissions are in the form of solid wastes; a much smaller amount is emitted to air, and less still to water. The form of the emissions determines their likely mobility, bioavailability and potential to reach and affect a target ecosystem or human population. Other important factors are whether the emissions are part of controlled, measured releases, uncontrolled fugitive emissions, or resulting from a plant incident.

Despite the recognition of historical environmental damage and health effects in the work force connected with the lead industry over many centuries, it is only in the past hundred or so years that effective control measures began to be implemented, both to protect the health of workers and to reduce pollution. Good plant design, with reduction of the potential for the emission of contaminating substances, is of paramount importance, and the newer smelting processes are inherently much cleaner than traditional blast furnaces. Pollution abatement technologies, including the treatment of exhaust gases and liquid effluents to remove a proportion of the metal content, have also significantly reduced emissions. Other general measures to improve the cleanliness of sites are implemented to varying degrees. These measures, taken together, have considerably reduced emissions.

Throughout the Western World, factories are legally required to operate within the limits on discharges set by their regulatory authority, although not all emissions are continuously monitored. In this respect, many plants in the EU have some form of perimeter monitoring. There are inherent problems in measuring fugitive emissions, such as windblown dusts, can be addressed by monitoring air quality within and at the perimeter of the site and modelling the results. In general it is difficult to estimate the percentage of the emission arising from fugitive sources. In certain countries allowable discharges are set individually for each plant.

There are legal limits and recommended guidelines for concentrations of lead in air outside plants, and monitoring is usually practised. Sites with the highest concentrations of lead in air are in the vicinity of industrial locations. Compliance with the former EU standard of 2µg/m^3 is now virtually universal, though there are still a few sites which exceed the new standard and the WHO guideline value of 0.5µg/m^3.

Those mostly exposed to releases within the plant are the workforce. Before industrial controls were introduced around the turn of the century, lead poisoning was common in foundry workers, and was also found in other trades which used lead. The implementation of controls such as maintaining minimum standards of air quality within the works, medical surveillance of employees, use of protective equipment, and provision of conditions of good hygiene in general, have made excessive occupational lead exposure a rare occurrence.

Outside the Western World, control measures are not always enforced to the same degree and there are still undoubtedly many cases of high occupational exposure to lead and environmental damage resulting from industrial emissions in the developing world.

In short, while it is important to recognise the huge improvements made by industry in recent decades, there are considerable variations between standards in the developed and the developing world. Emissions from some plants outside the EU continue to contribute towards elevated exposure of local residents, and high lead levels in soils leave a legacy for centuries. It is therefore important to continue to work toward implementation of best practice, and to aim for a level of emission that is globally sustainable.

8.1 INDUSTRIAL EMISSIONS

8.1.1 SOURCES OF EMISSIONS

Mining

Solid wastes - ores and mine tailings (the residual material after metal extraction, which may still contain significant amounts of the metal) stored on the ground can contaminate underlying soil. Dusts can be transported by wind onto surrounding land.

Airborne emissions - windblown dusts from mining operations and stock piles of ore can result in dispersion of lead downwind, though most is deposited on land nearby.

Water-borne emissions - from washing of ore and from water flowing past old mine wastes and mine shafts. This can continue to be a source of pollution long after the mine has ceased to operate.

Smelting and refining

Solid wastes - slags may contain up to a few percent of lead (typically less than 5%) and may also contain other contaminants such as arsenic and antimony. Silica slags mainly comprise glassy and crystalline phases which are subject to varying degrees of weathering, and which may release lead in more soluble forms. Lead has been found to occur in several different forms in weathered slags, including lead oxide (PbO), pyromorphite ($Pb_5(PO_4)_3Cl$), cerussite ($PbCO_3$), hydrocerussite ($Pb_3(CO_3)_2(OH)_2$), galena (PbS), anglesite ($PbSO_4$) and leadhillite ($Pb_4SO_4(CO_3)_2(OH)_2$) (Gee et al. 1996). Soda slags contain a lot of soluble metals. However, these will need to be phased out with ongoing environmental regulations. Dusts from pollution control equipment and drosses may contain lead and other metals in relatively active forms; these are usually recycled, though a small proportion containing for example arsenic and cadmium may be disposed of in landfill.

Airborne emissions - lead begins to fume significantly at temperatures above around 500°C. Vapours and dusts of lead and lead oxide, together with other materials present in the raw materials (such as acidic sulphur-containing gases, arsenic and other metals) can be present in air, both within the plant and the external environment. Protective measures are taken to reduce exposure to workers within the plant, where pollution abatement equipment is now mandatory.

Water-borne emissions - water used at several process stages and from surface rain water must be cleaned before discharging. Beside neutral salts it contains some lead, arsenic, tin, cadmium and other metal ions depending on the water cleaning technology used.

Manufacture of products containing lead

Though the main industrial emissions are generally from the extraction and production of metallic lead (INSERM, 1999), lead is used in a wide variety of products (as described in Chapter 3) and their manufacture also has the potential to release lead. These include batteries, some alloys, glass, ceramics, paints, ammunition and petrol, as well as pesticides and explosives (INSERM, 1999).

Other industries

Lead emissions occur from the following:

- metal works in general (including copper smelting and steelworks)
- incinerators of domestic and industrial waste
- power stations (as small amounts of lead and other metals are found in coal and oil)
- cement works

It should be noted however that these emissions are in the majority of cases well within the legal limits established in the relevant environmental regulations.

8.1.2 QUANTITIES OF EMISSIONS

The large scale of the modern lead industry inevitably leads to some accumulation of lead from fugitive emissions to soils around the works, despite strict environmental controls. In addition, some of the modern mines and smelters are located on the sites of older works, which have left a legacy of environmental contamination over hundreds of years. Very high levels of lead in soils (up to a few percent) have been found at locations of old mine workings, dressing floors and railway ore loading places. Levels decline rapidly away from the works but deposition of lead has been detected several kilometres away. In surveys around other smelters, maximum lead accumulations occur close to the stack. There is a rapid decline away and the distance - decline curve is usually exponential. It is difficult to be categorical about the soil lead levels likely to be encountered around lead smelters. However, on the basis of available data, it may be concluded that background levels of lead in soils are likely to be exceeded up to 3 km downwind of primary smelting activities.

Accumulations of lead may also be expected in the soils around secondary smelters and other lead using industries, though much of the contamination may be historical (Davies, 1995). For example, lead concentrations are elevated in surface soils (0 – 15 cm) up to 3.5 kilometres downwind of the only secondary lead smelter in Scandinavia, though the main area of contamination, with soils ranging up to 2,000 mg/kg lead, is limited to within 1 kilometre of the smelter

(Farago et al, 1999). Most of this contamination is thought to arise from the early operation of this facility which dates back to the 1940s. Measures taken by the operators since 1983 have resulted in reductions of lead emissions from about 2.25 tonnes per annum at that time to less than 0.5 tonnes by 1990.

Emissions from old mines and works, even from many centuries ago, continue to be a source of pollution in the environment. Sources of lead in the environment in general are discussed in Chapter 6.

Quantitative information on lead emissions to the atmosphere arising from lead production, manufacture, etc have been published but are difficult to validate. Estimates are subject to a high degree of uncertainty and tabulated information from different sources may show considerable variation. Thus while actual and projected emissions listed by country in Table 8.1 by Pacyna (1996) provide a useful database, more recent estimates published by TNO (1998) in Table 8.1b would indicate that these earlier data may well be over estimated.

TABLE 8.1 Emissions to Atmosphere from Lead Smelters (primary and secondary) in EU countries (estimated actual and projected data)

Emissions (tonnes) from 1955-1985, projected emissions to 2010						
Country	**1955**	**1965**	**1975**	**1985**	**2000***	**2010***
Austria	113.6	165.0	157.1	73.0	8.1	6.5
Belgium	1812.0	1100.0	651.5	195.4	250.6	218.5
Denmark	#	#	#	3.0	1.5	1.5
France	1034.0	1648.4	709.7	911.0	337.3	287.0
Germany (FDR)	3800.0	3900.0	1570.9	170.0		
Germany (DDR)	194.0	264.3	169.0	222.0		
Germany (total)	3994.0	4164.3	1739.9	392.0	76.4	59.7
Greece	6.4	21.3	37.5	27.0	31.6	30.2
Ireland	30.7	36.7	36.2	33.0	28.7	23.1
Italy	454.8	502.1	302.9	432.0	233.3	198.7
Luxembourg	1.1	1.8	0.8	#	#	#
Netherlands	212.6	392.4	6.0	1.7	0.2	0.1
Portugal	1.8	5.8	10.3	8.0	8.6	5.6
Spain	733.0	837.3	631.6	927.0	862.1	648.9
Sweden	289.3	644.3	250.0	110.0	24.6	22.4
United Kingdom	947.3	665.8	486.4	528.0	323.2	137.7
EU Total	**13786.1**	**14709.3**	**7278.4**	**4058.1**	**2186.2**	**1640.0**

* projected emissions # no data *(Pacyna, 1996)*

TABLE 8.1b Estimated and Projected Emissions (tonnes) of Lead from the Lead Industry in Europe

Estimated and Projected Emissions (tonnes/year x 10^2 of Lead)		
Region	**1990 (estimated)**	**2010 (projected)**
Western Europe	190	170
Southern Europe	150	140
Central and Eastern Europe	100	83

(TNO Report, January 1998)

8.1.3 NATURE OF EMISSIONS

Emissions generally can be categorised as point sources (from a single known source) or diffuse sources (such as from petrol or from sewage sludge applied to land). The nature of emissions can be controlled (e.g. from a stack after gas cleaning operations) or uncontrolled (i.e. fugitive emissions). Attempts are made to limit the latter with the use of water sprays and sweeping equipment within the perimeter of works' premises and by covering storage areas.

Controlled emissions include
- solid waste sent to landfill, spoil heaps (of mine tailings, slags etc.)
- stack emissions
- discharge outlets for liquid effluent.

These are from point sources and a consequence of routine operations. Both the quantity and nature of emissions are relatively easy to measure. Thus they can be regulated and controlled.

Fugitive emissions can include
- downward migration of metals into soil, from the storage of raw materials, scrap metals etc, though in modern plants these are usually present on a concrete base
- windblown dusts or solid matter carried on the wheels of vehicles
- waterborne runoff from site (e.g. from rain, washing, etc)
- leaks from equipment for storage or transportation of materials.

Such emissions may occur from sites of industrial processes, transport, storage or collection of lead-containing material. By definition, fugitive emissions are very difficult to quantify. Losses must be estimated by indirect means, such as mass balances, or by comparing predictions with actual measurements of concentrations of metals in surrounding air, water or land (procedures to reduce emissions are discussed later).

Uncontrolled emissions could also occur in the event of an incident at a site.

Type of emissions

Simply quoting the total quantity of lead emitted does not give much information about whether it is inert or potentially mobile.

Large amounts of solid waste are generated. In the EU, slags are mostly stored under cover. However, if they are stored dry in the open, dispersion by wind can carry dusts to surrounding areas. However some waste, particularly slags from primary smelting, are in a relatively inert form, so mobility and bioavailability will be low. Some lead-containing wastes such as flue dusts are usually recycled, though small amounts may be disposed of in controlled landfills as they are covered by special waste regulations. Though the potential for dispersal of these wastes in the short term is low, in the long term some migration is possible (as discussed in Chapter 6).

Emissions to water are frequently widely dispersed and have greater potential to interact with ecosystems. However, most data available show that fairly high concentrations of lead are needed to cause measured toxicity effects. It must be noted that most toxicity tests involve high doses on test animals for short times; this does not give clear information about effects of lower doses for longer times.

Emissions to air from chimneys, windblown dusts etc have the greatest potential to disperse, and thus may increase lead exposure in people living in the locality of lead processing plants. However, recent measurements have shown that ambient levels are generally below the 0.5µg/m^3 limit.

(Refer to Chapter 6 for further discussion about dispersion of lead in the environment, and to Chapter 7 for the sources of human exposure.)

8.1.4 LEAD DEPOSITION

Quantitative measurements of lead deposition are difficult to obtain and much of the published information is based on calculations from computer-based models such as TRACE - developed at IIASA to compute air concentrations and depositions of metals including lead on a European scale (Olendrzynski et al 1996). This approach, which accepts a high level of uncertainty, calculates the highest cumulative lead deposition over the period 1955-1987, exceeding 20 mg/m^2 in France, Germany and the UK.

A specific study in the UK which monitored deposition of 23 elements onto agricultural land at 34 locations over a period of 3 years to 1999, reported lead deposition ranging from 19.5 to 139.0, median 43.4g/ha/year (Alloway et.al, 1999).

8.1.5 IMPACTS OF INDUSTRIAL EMISSIONS

Risk assessment techniques can be used to calculate and predict the impacts of contamination on people and ecosystems. As discussed in Chapter 7, the presence of lead does not in itself present a risk. For example, lead in an inert form, underground, is unlikely to have a direct impact upon human health unless it migrates significantly, is exposed at the surface, or has some other pathway to reach a “target” population. Risk assessments can predict the likelihood of different types of emissions causing harm to workers, to other people in the area and to ecosystems.

However, it must be stressed that risk assessments always contain uncertainty. The behaviour of materials, particularly in the future, is not known, and predictions are invariably based upon assumptions and incomplete data, and different calculation can yield differing results. For risk assessments to be useful, assumptions and uncertainties must be clearly stated.

The following targets may be considered:

Table 8.2 Potential for Lead Exposure among Target Groups

Target	Potential effect
workers	occupational exposure
families of workers	elevated exposure
local residents	elevated exposure
the local environment	increased burdens of lead and other metals in soils, potential impact on ecosystems
the wider environment	increased burdens of lead and other metals, potential impact on ecosystems (much smaller)

Occupational exposure

Historical situation

Illness resulting from exposure to lead in the workplace used to be common. Prior to 1895, when control measures were implemented, over 70% of workers at a lead smelting works in Hungary (Schemnitz) were reported to suffer lead poisoning (Hamilton, 1914, cited in Nriagu, 1983). In the UK, at around the same time, there were many thousands of cases every year. Exposure was not confined to workers employed in the manufacture of lead and its compounds. Recorded cases of lead colic in a Paris hospital from 1830-1838 included patients who were painters, potters, plumbers, workers in production of lead shot and a small number of glazers and workers in glass factories (Tanquerel des Planches, 1848 cited in Nriagu, 1983).

Present situation

As a result of implementation of procedures to improve health and safety at work, the number of cases of occupational lead poisoning is now extremely small. However, there are many different industrial activities during which workers can be exposed, which include: production and refining of metal, construction and demolition of structures painted with leaded paint, preparation of stabilisers for PVC or additives to glass, sanding down leaded paint and the manufacture of lead batteries.

In France, the number of cases of occupational lead poisoning since 1969 peaked at over 200 in the early 1970s and declined to around 15-50 per year from the early 1980s to 1992 (INSERM, 1999). In the UK, in the period 1988-1998, there were 32 reported cases of lead poisoning in the workplace, with between 0 and 7 per year (UK Health and Safety Statistics Book 1997-1998). There may be differences in the definition of “lead poisoning” and reporting procedures between these two countries, so these figures should not be compared directly.

Though cases of lead poisoning are now extremely rare, less obvious effects on health can occur in some individuals at even moderate exposure levels, as discussed in Chapter 7.

Workers in small businesses, for example ornamental casting or jewellery makers and casual workers, can be at greater risk as they or their employers may not be aware of necessary procedures to reduce exposure. They are also much less likely to undergo routine medical surveillance (CECAD-Plomb, 1996).

Elevated environmental exposure

Emissions from industry can contribute to elevated concentrations of lead in air (refer to section 8.3 for fuller discussion) and soils, both at the plant itself and nearby. Soil lead concentrations can be very high in locations where solid process wastes are stored, particularly around some processing plants. However, modern covered storage practices have reduced this problem. These wastes may be in a fairly immobile, unavailable form (such as some slags from lead smelting); less stable forms of lead can be prone to leaching or removal by wind, which transports the lead containing dusts. Airborne particles fall to earth and contribute to elevated levels of lead in soils and dusts (refer to Chapter 6 for discussion about fates of lead in the environment and the importance of the form which it is in). This can be a pathway to human exposure.

High levels of lead in soils in the vicinity of industrial sites frequently occur, though these are not necessarily harmful. The significance of this for humans again depends upon such factors as the chemical form of the lead and its solubility, and whether or not people have access to the site. Risk assessments make predictions on exposures, which may or may not prove accurate. Effects on ecosystems are less well known. Available data suggest that, though living organisms can be affected by exposure to lead, high concentrations are required to give noticeable effects.

8.2 CONTROL MEASURES

8.2.1 HISTORICAL BACKGROUND

Impacts of metallurgical industries on workers' health and the environment have been noted since ancient times, though few controls were implemented. Reference was made (by Pliny and several others, cited in Nriagu, 1983) to foundry workers and miners tying cloths around their faces to protect them from the metal fume and dust. A review of reasons for closure of lead-silver mines (and banning of gold and silver as currency) during part of the Ancient Greek era, was considered partly to avoid the environmental damage caused by mining (Del Mar, 1880, cited in Nriagu, 1983).

At the end of the 19th century, reported cases of workers suffering ill effects from lead poisoning were estimated at thousands, with many deaths. Measures to improve standards of health and safety in the workplace began in Europe around 1900.

8.2.2 MEASURES TO CONTROL LOSSES OF LEAD TO THE ENVIRONMENT

Enterprises which produce or use lead are required to conform with regulations to:

- protect the health of their workers, and
- control releases to the environment.

A full account of such measures would require a detailed description of the individual processes, which is beyond the scope of this book. However, certain principles and measures are in common use.

Minimisation of discharges is always preferable to attempts to clean up emissions. The avoidance of pollution is now a factor in selecting the site design and layout (for example, storage of materials on a suitable surface and under cover, to avoid removal by wind, rain and seepage to earth), and choice of suitable equipment (such as enclosed systems for conveying powdered materials and molten lead).

Emissions inevitably occur in the course of operations. Recommended procedures which reduce the amount of dust (including condensed lead vapour) in the air within the plant include:

- regular cleaning to prevent accumulations of dust,
- the use of water sprays around the site,
- fume extraction, for specific operations, and for whole buildings,
- closed systems for handling dirty materials.

Treatments to reduce the quantity of discharges include:

- treatment of exhaust gases to remove most of the dust (termed flue dust) and acidic gases,
- collection and treatment of liquid effluent to remove most of the dissolved or suspended metal,
- washing vehicles before they leave site.

The efficiency of these procedures is usually assessed by the monitoring of lead in air, both at the plant boundary and up to several kilometres away (particularly in nearby populated areas).

The lead-containing solids collected in the cleaning equipment are often returned to the smelter to make use of their lead content. Similarly, flue dusts etc. from other industries (e.g. copper smelting and steelworks) are also treated at smelters. Procedures to reduce emissions of these very light dusts are important, and they are commonly transported in a damp form. Alternatively, small amounts of flue dusts are disposed of to landfill. The choice of disposal route is generally on economic grounds, and depends on the composition of the dust and the relative charges of landfill disposal.

There are various alternative technologies for the collection of such emissions, which have differing degrees of effectiveness (no measure is 100% effective, though very high removal rates are possible), suitability for different processes and costs.

In many countries factories are licensed to allow emissions up to levels set by the regulatory authority. Regulations regarding monitoring and reporting of discharges are set. Some emissions are continuously monitored, including concentrations of metals in liquid effluent and in stack emissions. In some smaller plants monitoring is not done continuously when limits are not likely to be exceeded; however, samples are taken periodically and these are used to estimate total emissions.

8.2.3 CHOICE OF PROCESS

It is unrealistic to expect plants built to older specifications to operate to the same standards (in terms of emissions and energy efficiency) as modern plants which use newer technologies. For example, the traditional blast furnace allows much greater opportunity for the escape and discharge of materials than the newer, inherently cleaner, single-stage processes for smelting ore. The Kivcet furnace, which is one example of a single-stage smelting furnace, is considered a "Best Available Technique" (BAT) by the UK pollution inspectorate (UK HMIP, 1993) for processing lead concentrates (while the Imperial Smelting Process, similar to the blast furnace, but allowing for simultaneous lead and zinc removal, is considered BAT for mixed lead/zinc concentrates). Modifications to existing older furnaces can achieve the lower specifications needed to comply with "Best Available Technique Not Entailing Excessive Cost" (BATNEEC) status.

8.2.4 ADDITIONAL MEASURES TO PROTECT THE HEALTH OF EMPLOYEES

- Regular cleaning of the workplace to avoid accumulations of dusts.
- Monitoring air lead concentrations and observing limits. The maximum permissible workplace level of lead in air in the EU is 0.15mg/m^3 (as specified in Directive 82/605 on Risks at Work due to Lead (1982)). Some Member States have stricter regulations (ILZSG, 1996). However, opinion is divided about the choice of standards adopted and their usefulness in assessing the risk to workers. It is deemed risky to assume that compliance with a set air concentration will by itself guarantee protection to workers, especially considering the variability in exposures and absorption of lead between individual workers (CECAD-Plomb, 1996).
- Use of appropriate personal protection equipment (particularly respiratory protection).
- Periodic screening of employees for general health and lead exposure. There are statutory levels of exposure above which the employer must take action to reduce the exposure of the individual, and above which the individual must be removed from the area where he will be exposed to lead.
- Good hygiene practices can do much to reduce the exposure of personnel, for example: provision of clean areas for eating and drinking; provision of clothes to be worn on site and changed when leaving (this also eliminates a pathway for the exposure of the families of workers); discouraging/not allowing smoking on site; encouraging hand washing before eating.

8.3 EXAMPLES OF THE CURRENT STATE OF EMISSIONS BY INDUSTRY

France

The Ministry of the Environment in France lists 40 installations which emit lead and its compounds to air (Ministrie de l'Amenagement du Territoire et de l'Environnement, 1997). In 1996, these were between 0.2 and 67.4kg per day (to atmosphere). Five of these sites emitted over 10kg of lead per day. These included foundries, factories which manufacture batteries and lead additives, and incinerators of municipal waste.

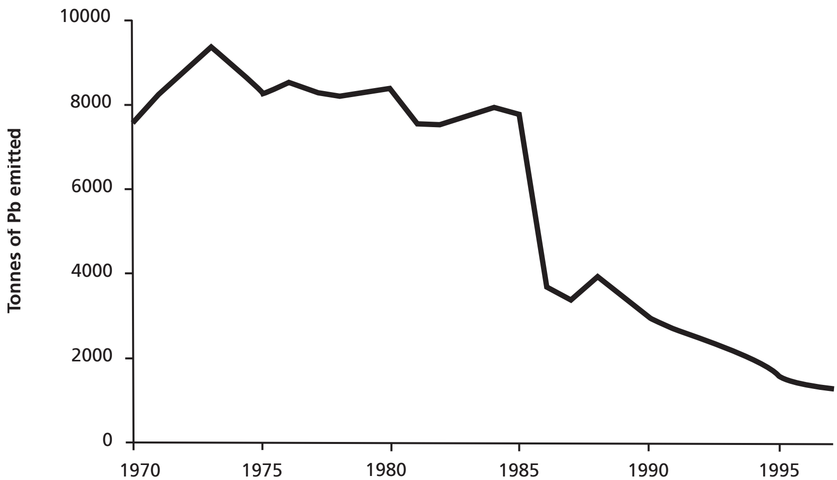
The highest concentrations of lead in air are found at sites which are affected by municipal waste incinerators and industrial sources, in particular primary lead and lead additives production. Even though industrial emissions have decreased since the 1960s following regulations to control pollution, reductions are still being observed (mean annual lead concentrations in air in 31 industrial monitoring sites, mainly in the Nord-Pas-de-Calais region, declined by 27% between 1992 and 1995) (ADEME, 1997; INSERM, 1999). 70% of these sites showed an annual average below 0.41µg/m^3 and 90% were below 0.56µg/m^3. Although the majority of 62 monitoring sites in industrial and urban areas had acceptably low ambient air concentrations of lead, a small proportion (in 1995, 18% of monitoring sites near industrial sources of lead pollution, and one town centre site out of about 30), exceeded the World Health Organisation recommended level (and new EU limit from 2005) of 0.5µg/m^3 lead in air (annual arithmetic mean) (World Health Organisation, 1987). All the industrial monitoring stations meet the old European value of 2µg/m^3. Short term concentrations can be very much higher (3 sites recorded mean values of the maximum concentrations over 24 hours of over 20µg/m^3, though it is the long-term average concentrations which are important). Short term concentrations are an important factor in monitoring discharges from plants, though impacts to human health depend upon total exposure over a period of months or even years.

The INSERM Report (1999) concluded that, despite the progress made in France, it is still necessary to maintain the efforts undertaken [to improve air quality], particularly concerning emissions and monitoring of lead from industrial sources. This is of importance as the new EU Daughter Directive on Ambient Air Quality published in 1999 establishes a new limit value for lead of 0.5µg/m^3 measured as an annual average. This will eventually become effective on 1 January 2005 being successively reduced by 0.1µg/m^3 each year for the previous five years. Derogations will be available for some industrial sites up to 2010.

UK

In the UK, air quality measurements taken some 10 years ago at 24 sites, including eight sites close to large lead works, found that only one industrial site exceeded the EU statutory limit of 2µg/m^3 lead in air between 1985 and the end of 1989. Since 1990 this site has complied with the limit. However, up to and including 1996, two industrial sites continued to exceed the WHO recommended guideline of 0.5µg/m^3 (UK DETR, 1998). It should be noted that an Air Quality Standard for lead in the United Kingdom of 0.25µg/m^3 measured as an annual average has been agreed and will come into force in 2009. However, plants will not be required to go beyond Best Available Techniques to achieve this limit (UK – DETR, 1998).

Overall emissions of lead to the atmosphere in the UK have fallen considerably from the 1970s and early 1980s to the present time (see Figure 8.1); the greatest fall can be associated with the reduction in sales of leaded gasoline (and the lower permissible maximum lead content of gasoline of 0.15g/l introduced in 1985).



(Source: UK National Atmospheric Emissions Inventory)

Figure 8.1 UK Emissions of Lead to Air

Emissions from industry outside the EU

Despite the enormous improvements in emissions control achieved in the developed world there are still some plants in newly industrialising countries which do not operate to strict environmental standards. Some such installations are sources of severe environmental contamination, and some workers (and possibly local residents) can suffer health damage as a result.

As lead is very easy to melt, it lends itself to being processed by small scrap collectors (particularly in less developed countries) and in such enterprises there are unlikely to be controls, thus workers and their families can be highly exposed.

The lead industry has set up and funds the International Lead Management Center as a vehicle for the transfer of information on good practice to plants in developing areas. This organisation is currently involved in projects in many countries, with the aims of reducing occupational exposure and limiting releases to the environment.

Conclusion

The production of lead and other metals, together with some other manufacturing processes, gives the potential for contamination within the work place and in the surrounding environment. However, good practice by industry and regulatory measures to limit pollution and safeguard the health of employees have resulted in dramatic reductions in emissions to the environment, and cases of occupational lead poisoning are now very rare. However, though many sites observe strict procedures to limit discharges, some older plants continue to be less efficient than modern facilities. These emissions, particularly in central and Eastern Europe and in some developing countries continue to result in elevated levels of lead in air, soil and water. This in turn can lead to elevated levels of exposure in local populations. Historical contamination of soils at some industrial locations will continue to be a source of contamination for many centuries. Emission and thus deposition of lead in the future must of necessity be minimised.