INDUSTRIAL SITE REMEDIATION

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Summary

The recycling of old industrial sites is essential for the regeneration of urban and industrial areas. However, the buildings and underlying ground, and groundwater, are often contaminated with potentially hazardous substances. Contamination typically arises from spills, leaks, and deliberate on-site disposal of raw materials, process intermediates, and wastes. To avoid harm to human health and safety, the environment, and ecosystems etc. it is essential to determine the nature, amount, and distribution of contamination through appropriate investigations of buildings, old plant, the ground, and the water environment.

Potential hazards must be identified and associated risks assessed in a systematic way. Assessments of ground and groundwater contamination may be made using generic guideline values developed for the purpose and/or using site-specific estimates of risks. Remediation methods to avoid, remove, and eliminate or control risks should be selected in a systematic and transparent way. Many jurisdictions have legislated for the

identification of potentially contaminated sites, mandatory action to deal with "problem" sites that are an immediate threat to human health or the environment; to control the re-development and re-use of buildings and sites that may be contaminated. Whilst there is a large legacy from the past to be cleaned-up, recent legislation in many jurisdictions requires site occupiers to preserve the quality of the land that they temporarily occupy. This should help to reduce problems in future years.

1. Introduction

During use for industry, commerce, and waste disposal, land commonly becomes contaminated with potentially hazardous substances and materials. These substances and materials may be hazardous to humans (e.g. because they are toxic), ecological systems, the water environment, structures, and, on occasion, other targets. Industrial site remediation is the process whereby the hazards and risks posed by potentially hazardous substances are identified and assessed, and the site then made fit for a similar or different purpose. More narrowly, remediation is applied to activities to deal with hazards and risks once they have been identified and assessed.

The problems posed by contaminated sites were recognized in a number of countries (e.g. Germany, the Netherlands, United Kingdom, and USA) over twenty years ago. Many industrialized countries have established legally based regimes for identification of contaminated sites, to require remediation where this is essential to protect human health or the environment, and to control re-development for a similar or different use. Sites posing problems may have been closed (the principal subject of this article) or may still be in active use.

Much of what is written in the technical literature and many of the legal frameworks that have been established appear to assume that sites will only be assessed once clearance of old plant and buildings has been completed. However, because the process of site closure involving dismantling plant and demolishing buildings may lead to a spread of contamination, thinking about how to deal with residual contamination and re-development should begin the moment consideration is given to closing a plant.

Contamination of sites through stockpiling of raw materials, products and fuel (e.g. coal), deliberate deposition of wastes, and accidental spills and leaks has been viewed until recently as an inevitable consequence of using land for industry. This attitude is becoming harder to sustain and legislation is being introduced in various jurisdictions to make those using land responsible for maintaining its quality in the long-term (e.g. Integrated Pollution Prevention and Control (IPPC) in the European Union).

There are then two principal stages to the remediation of an industrial site:

- Site closure.
- Site re-development.

The literature and guidance dealing with the latter is far more extensive than about the former. However, many jurisdictions will have formal codes of practice regarding the physical activities involved in demolition, which deal in more or less detail with

potential chemical and other forms of contamination, and the way it may affect the demolition process.

In some cases closure of an industrial operation will be followed by re-use of the buildings (sometimes the plant itself) for another industrial use. In addition, in many urban areas there is a trend towards the conversion of former industrial and commercial buildings for residential occupation. There will remain a need in such instances to properly investigate and assess buildings; and to carry out any necessary remedial or protective works before re-use in this way.

Two distinct philosophies have emerged during the past twenty years concerning the remediation of contaminated sites. The one was characterized as making land fit for any future purpose (multi-functional) whilst the other was characterized as making land fit for the current or intended immediate use (fit for purpose). In practice there has been convergence on an intermediate position in most jurisdictions.

It has been recognized that it is not always technically possible to achieve multi-functionality, certainly not except at excessive cost, and also that it does not always make sense where there is a regional wide pollution problem affecting many contiguous sites. The fit for purpose approach, whilst satisfying regulators and developers does not always satisfy investors or those who are to live on the land. Nor may it be regarded by some as fully "sustainable" as it leaves potential problems to be dealt with again by future generations.

Since the early 1970s there has been extensive international collaboration between countries at official levels on all aspects of contaminated land including policy formulation, site investigation, risk assessment, and remediation of contaminated land and groundwater particularly in Europe and North America. In addition, organizations such as the International Organization for Standardization (ISO), and the UN Food and Agriculture Organization have become involved.

2. Contamination and Pollution

A distinction is made in this article between "contamination" and "pollution". Put simply, contamination is the presence in the environment of a (potentially hazardous) substance or agent as a result of human activity. No judgment is implied by the term as to whether the contamination is causing or is likely to cause harm to humans or some other target. This judgment can only be made following proper investigation and assessment. Following this it may then be possible to say that a contaminant or contaminants are present in sufficient concentration or quantity as to cause harm or to be very likely to cause harm to one or more identified targets, i.e. the land, water or building etc. is "polluted". Given the definitions above, there can be no such thing as "natural contamination" only "naturally elevated concentrations of potentially harmful substances".

This useful distinction between contamination and pollution was first made in the United Kingdom about twenty years ago although this distinction is not always maintained in either formal guidance literature or legislative provisions.

Contamination may be chemical, radiochemical or biological (e.g. pathogenic organisms such as anthrax spores), and is often taken to embrace hazards from combustibility of fill materials and volume instability of some metallurgical slags. Hazards may be to humans, animals (wild and domesticated), plants (natural and cultivated), the water environment, ecosystems (macro- and micro-), buildings, and other structures and economic resources.

All land used for industry, commerce or waste disposal should be regarded as suspect. Land surrounding industrial premises may also become contaminated, for example due to aerial deposition and migration of contaminated groundwater. Much urban land in general is also contaminated due to aerial deposition, flaking of lead paints and galvanized metals, and domestic activities such as putting soot and coal ash in gardens. Some agricultural land may be contaminated due to over-use of agrochemicals and use of wastes such as sewage sludge.

3. Overall Approach

Whether dealing with the site closure phase or subsequent re-development the overall approach required is similar and can be characterized as one of “risk management” (it should be noted that terminology is not internationally standardized and that such terms as “risk management” may be used differently in different contexts).

The essential stages are:

- Recognition that contamination is a potential problem, and that there is a need for a planned and systematic approach to site closure, and/or re-development.
- Identification from documentary sources etc. of potential contaminants and the hazards associated with them (Hazard Identification).
- Investigation to determine what is present, where it is, and how much there is.
- Determination of whether any contamination that is present “matters” and if so what should be done about it (Hazard Assessment, Risk Estimation, and Risk Evaluation).
- Implementation of decontamination, protective or other measures (i.e. remediation) to make the buildings and/or site fit for re-use.

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Biographical Sketch

Michael Alan Smith: BSc, CChem, CGeol, FRSC, MCIWEM, MIM, FGS. Mike Smith is a self-employed environmental consultant. He has over twenty years' experience of dealing with all aspects of contaminated land. He was previously the first Secretary of the United Kingdom's Interdepartmental Committee on the Redevelopment of Contaminated Land (1977–80), Head of the Building Research Establishment's Contaminated Land Section (1980–85), and a Director of a leading UK environmental consultancy (1985–95). He has participated in various international studies concerned with contaminated land including the NATO Committee on the Challenges of Modern Society (CCMS) Pilot Studies on the remediation of contaminated soils and groundwater (1981–2000+). He has contributed to the preparation of technical guidance at national and international level (e.g. preparation of British and International Standards). He is a co-author of guidance texts on site investigation, risk assessment, and remediation.

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