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October 1990

INTERDEPARTMENTAL COMMITTEE ON THE REDEVELOPMENT OF CONTAMINATED LAND

Asbestos on contaminated sites

Recycled Paper

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ASBESTOS ON CONTAMINATED SITES

SUMMARY

Asbestos* found on the surface of, or buried at shallow depth on, abandoned former industrial premises or waste disposal sites can be a hazard to health. Remedial action may have to be taken by land owners or users, or by local authorities, to reduce the risks. This paper provides guidance on the investigation, assessment and treatment of such sites.

I INTRODUCTION

1. Sites contaminated by asbestos may present hazards to the public or to grazing animals. Asbestos on a site, especially if dispersed, is also likely to cause problems with reclamation or re-use of the land.

2. The purpose of this paper is to provide some general guidance on the identification, assessment and treatment of such sites to enable those responsible for acquiring, selling or developing land to proceed safely and without unnecessary risk.

3. Guidance on the disposal of asbestos wastes is given in DOE Waste Management Paper No 18(1), and in the Institute of Wastes Management Code of Practice for the disposal of asbestos waste(2). Asbestos is a very stable material which under normal circumstances will persist indefinitely. In consequence treatments to destroy the asbestos fibres are to be preferred to burial where there is no guarantee that re-exposure will not occur. All work with asbestos - containing materials will be subject to the Control of Asbestos at Work Regulations 1987(3). These regulations apply when work is being done with or on asbestos (or material containing it), but not when the asbestos (or asbestos - containing material) is left undisturbed, for example where it is buried in the soil and no work activity with it is undertaken. The Health and Safety Executive (HSE) provides advice on the safe handling of old or new asbestos wastes and publishes guidance on the removal of asbestos during demolition work on buildings (4-7).

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* Asbestos is the generic name given to a number of naturally occurring fibrous silicates. For the purpose of this paper, no distinction is made between crocidolite (blue), amosite (brown) or chrysotile (white asbestos). In general, however, the fibres of crocidolite and amosite are regarded as the most hazardous if inhaled. Although the common names based on colour are often used, in practice the apparent colour of the material is not a reliable guide to the type of asbestos which is present.

II SITES WHICH MAY CONTAIN ASBESTOS

4. Abandoned industrial premises, former waste disposal sites (including those reclaimed for agricultural or amenity use etc) and other derelict or unused land are likely to be contaminated by buried asbestos. At some sites, asbestos may also be present above ground, eg on sites where it was used for heat insulation (as lagging for pipes or tanks), for fire control, or in the construction of walls and roofs of buildings. The following are examples of sites where asbestos may be most likely to occur:

i former railway land, especially large workshops, depots and siding areas;

ii heavy engineering sites eg shipbuilders/shiprepairers/shipbreakers yards;

iii old waste disposal sites, especially those pre-dating current legislation and controls;

iv sites where asbestos-based products were manufactured;

v scrap yards; and

vi power stations.

5. The major usage of asbestos in the UK was and still is of chrysotile (white) asbestos, which is mainly used for asbestos-cement products, jointings and packings, friction materials, floor tiles and coverings, and for fillers and reinforcement in felts, mastics coatings etc. Amosite (brown) asbestos was principally used for fire resistant board and some asbestos-cement pipes. Crocidolite (blue) asbestos was extensively used in insulation materials in chemical and gas works, in power stations, in thermal and sound proofing materials in railway rolling stock and in sprayed coatings.

III HAZARDS AND EXPOSURE ASSESSMENT

6. The principal hazard is irrepairable damage to the respiratory system from inhalation of fibres of asbestos, or dust containing it. The fibres or dust may be released into the atmosphere from materials present on the site, including materials buried at insufficient depth, by weathering, erosion or disturbance, for example by vehicle movements or construction work. Lateral or vertical movement of fibres into surface watercourses or underground aquifers may also occur, and although these hazards are negligible by comparison with those of airborne asbestos fibres, the National Rivers Authority should be consulted where such releases to water can be expected to take place.

7. The tendency for fibres to be released into the air is increased if the asbestos is present in the form of friable materials such as old lagging blankets and insulating boards or as loose unconsolidated deposits. If the site is dry, well-drained and overlain by coarse-grained granular soil or fill, the fibres tend to become airborne more readily. Laboratory studies carried out on samples with homogeneous asbestos contamination have shown that concentrations of respirable

fibres of asbestos in soil as low as 0.001% by weight may, in loose dry soils, give rise to measurable levels of airborne fibres if disturbed(9). Release of fibres tends to be reduced when the asbestos is present in the form of manufactured articles such as asbestos-cement boards, sheets and pipes, or if the site is wet, poorly drained or covered by fine-grained material (such as clay) which prevents the fibres from escaping into the atmosphere. There should, therefore, be a significant difference between the amount of asbestos released on disturbance of soil evenly contaminated with loose fibres, and the amount released from soil containing discrete pieces of asbestos-based products. In the latter case the amount of airborne asbestos may be low enough to significantly reduce the precautions necessary: this factor should be considered in the site assessment.

IV SURVEY TECHNIQUES FOR INVESTIGATING THE EXTENT OF ASBESTOS BURIED ON SITES

8. The first need is to investigate the site in order to determine the extent of contamination, and then assess what further action, if any, is needed.

9. The following stages are based on the systematic approach outlined in other ICRCL guidance notes (see list on back cover): see also the British Standards Institution Draft Code of Practice for the identification and investigation of potentially contaminated land (8).

9.1 Adequate historical information about the site should be obtained by inspection of available records of site use, collection of site plans, aerial photographs, and maps (eg Ordnance Survey), and examination of any leases or contracts which may have been negotiated concerning the use of parts of the site; former employees may also be able to supply useful details. If this information indicates that asbestos was used, a site survey should be carried out to define the area likely to be affected and estimate the quantity of asbestos contaminated material present.

9.2 A preliminary visual inspection of the surface and exposed areas of the site should be made. If asbestos is found or other fibrous materials observed, the locations of the contaminated areas should be recorded on a site plan. Samples should subsequently be taken to identify the materials present (see 9.4). Precautions are needed during investigation (see para 14 et seq). It should be noted that asbestos becomes more readily visible after the soil has been wetted.

9.3 Where information about the site derived from knowledge of its history or from visual inspection, suggests that there is the possibility that asbestos may be present below the surface of the site, any filled areas, underground structures or other areas of the site likely to contain asbestos should be identified and a systematic grid pattern of sampling points established to cover the contaminated areas. The grid spacing should be chosen such that an adequate number of samples can be obtained from these areas either from boreholes or trial pits excavated by a mechanical digger(8). The depth of sampling should be at least 2 metres, or greater if the ground is likely to be disturbed during any landscaping or construction work. Trial pits have the advantage of allowing the ground conditions at depth to be observed directly, but if the site is heavily contaminated it may be better to use boreholes in order to minimise disturbance. During sampling, with adequate safety precautions, records

should be kept of any asbestos found and of the hydrogeology of the site. Care should be taken to avoid the possibility of cross-contamination of different depths.

9.4 When discrete fragments of asbestos are found on the surface or at depth it may not be necessary to measure the actual concentration present. The type of asbestos present should, however, be confirmed by an appropriate technique (polarised light microscopy, x-ray diffraction, scanning electron microscopy or transmission electron microscopy), or alternatively it can be assumed that asbestos present is crocidolite (blue) or amosite (brown). The whole area represented by such sample(s) should be regarded as contaminated and appropriate action taken.

9.5 If the proportion of asbestos is too low to enable fragments to be observed, the individual fibres in the sample can be detected only by an instrumental technique. Any analytical method intended to be used for the determination of low concentrations of asbestos in soils should be sensitive enough to enable detection of concentrations of respirable fibres at least as low as 0.001%, by weight (see Reference 9). It is possible that such samples are indicative of more serious contamination in the vicinity of the sampling locations, and further samples should be taken to test this possibility. Individual fibres present in or near the surface layers could still be released especially if the soil became dry: they tend to become airborne far more readily than small fragments of asbestos.

9.6 If the samples are free from asbestos the site can be dealt with normally subject to the proviso that although asbestos was not found at the sampling points, this does not preclude its presence elsewhere on the site.

V ASSESSMENT OF FINDINGS

10. Under the Control of Asbestos at Work Regulations (3) any employer carrying out work which is likely to expose his employees (and others) to asbestos is required to make an assessment which should:

i identify the type of asbestos or assume that it is crocidolite (blue) or amosite (brown);

ii determine the nature and degree of exposure; and

iii set out steps to prevent any such exposure or reduce it to the lowest level reasonably practicable.

The assessment should be in writing unless the work involves low level exposure and is simple so that it can be easily repeated and explained.

11. Concentrations of respirable fibres of asbestos in dry soils of 0.001% by weight have been shown in laboratory studies to produce airborne respirable asbestos concentrations in excess of 0.1 fibre/ml in dust clouds where the respirable dust concentration is below 5 mg/m^3 (9). Consequently, wherever asbestos (especially finely dispersed or fibrous) is present in soil,

precautions should be taken to minimise exposure to airborne fibres. The addition of water can be an effective method of reducing the airborne fibre concentrations; the amount of water required to reduce the fibre concentrations to a specified value depends principally on the degree of contamination and to a lesser extent on the type of soil. In laboratory studies, the addition of water equivalent to 10% of the dry weight of the contaminated soil reduced the airborne fibre concentrations by a factor of about 10.

12. The following factors need to be taken into account in assessing the risks and in deciding what action is required:

i the amount and form of the contamination;

ii the location of the site, and its position in relation to housing, schools etc;

iii the present use of the land;

iv the ease of public access; and

v the proposed future use of the land, including construction activities.

13. The environmental health department of the relevant local authority should be consulted on the need for and form of any immediate action required in order to minimise risks to public health. If risks to health (whether to those on site or to members of the public) arise because of site activities, the HSE is the enforcing authority. Where it is agreed that there are risks to health, immediate action will be necessary by the land owner or user at least to ensure the security of the site in order to restrict or prevent access.

VI PRECAUTIONS

14. Site inspections and investigations should be conducted in such a way that:

i asbestos fibres are not carried off the site or distributed over the surrounding area; and

ii the tendency for dust to be produced is minimised.

15. The following is the minimum personal protection required:

Operation	Protection
i Visual surface surveys	Wellingtons or other suitable footwear which can be washed down before leaving the site. Disposable overalls may be needed on heavily contaminated sites.
ii Collecting asbestos to remove small quantities from sites.	Wellingtons, suitable overalls and high efficiency respirators.

iii Removing asbestos-contaminated material from site.	Full protective clothing. Full face high efficiency respirators or positive pressure respirators. Facilities for washing may be required.

See reference 2 for further guidance on clothing and safety equipment.

16. Of primary importance is the strict management control of activities on sites contaminated with asbestos. The generation of airborne fibres may result from poor handling practices, including misuse of vehicles and equipment. Regular monitoring of the site should be part of the total control package. Additional precautions will be needed for any large-scale excavation, removal or burial of asbestos-contaminated material during subsequent reclamation operations. Such precautions should include decontamination facilities, together with suitable methods for disposal of contaminated clothing. During the excavation of contaminated ground prior to its removal for disposal, on-site showers and washing facilities are essential. Decontamination of all vehicles before they leave the site may also be necessary, eg by water sprays. Care will be necessary to ensure that asbestos-contaminated water does not escape from the site, or dry out so that fibres are released into the air: washings should be treated as asbestos waste and disposed of accordingly (2). In dry weather, dust suppression will be required when excavating and removing contaminated material. This can be achieved by spray application of water to the working area before work commences. The generation of respirable asbestos fibres can be considerably reduced by the addition of suitable quantities of water (9). The manner in which water is added prior to handling asbestos contaminated soils needs to be considered carefully: if added too soon, drying out may take place; too late and the surface may become waterlogged while underlying materials remain relatively unaffected. In some circumstances it may be necessary to cover the dampened area with sheeting to allow moisture penetration while preventing drying of the surface. The precise procedures to be adopted will depend on the nature and condition of the ground and as such will be site specific.

VII MONITORING

17. Monitoring of fibre concentrations will be necessary to ensure the effectiveness of precautions during sampling and any subsequent treatment or disposal operations. The membrane filter/optical counting technique is best suited to the requirements but sample volumes of approximately $0.5m^3$ may be required to obtain adequate sensitivity (10).

18. Concentrations of asbestos in air should be measured during sampling and any subsequent treatment or disposal operations. Where decontamination units are used the "clean end" of the unit should be monitored to check decontamination procedures. Static perimeter monitoring should be carried out to ensure that spread of asbestos off-site is adequately controlled. Such measurements are needed:

i to establish the concentrations to which workers on the site may be exposed;

ii to provide warning in case significant quantities of dust are produced: if such conditions occur, the method of working may need to be changed or the work suspended; and

iii to provide reassurance to those outside the site.

VIII REMEDIAL TREATMENT

19. The following methods are available:

i excavation (where necessary) and removal from the site for disposal elsewhere;

ii excavation (where necessary) and retention on the site for re-burial at a greater depth;

iii covering by a suitable depth of inert material or by a permanent hard-surfaced form of development; and

iv excavation (where necessary) and treatment prior to disposal by burial on the same site or elsewhere.

IX DISPOSAL

20. Methods for handling and disposal of asbestos waste depend mainly on the physical nature of the material. All asbestos wastes are subject to control and can only be disposed of at sites specifically licensed for the purpose (11). Wastes capable of releasing free asbestos fibres or dust are subject to additional controls. Removal of asbestos from a contaminated site is more practicable when it is present mainly as discrete pieces of reasonable size; for example complete or substantial fragments of lagging materials which could be collected and contained in appropriate bags for disposal without undue difficulty. When the asbestos is present in the form of manufactured products such as asbestos-cement pipes removal from the site is, in principle, simple, but not necessarily essential: if the products are in a relatively undamaged state they are less likely to release fibres than if they are badly deteriorated by damage or weathering. A decision on whether or not to remove them from the site therefore depends on their nature, condition, and quantity.

21. When the asbestos is present in the form of small fragments well mixed with other fill material, it is difficult to separate the asbestos for disposal without also excavating and disposing of considerable amounts of inert uncontaminated material. The handling problems, and the costs of disposal, may then be so great as to preclude complete removal as an option for remedial treatment. In such circumstances removal is therefore best regarded as the measure of last resort.

22. If removal of any form of asbestos from the site for disposal elsewhere is planned, the relevant Waste Disposal Authority and the local office of the Health and Safety Executive must be consulted. Appropriate protection will be needed by the workers who will have to collect or handle the material (see paras 15-16).

X RETENTION

23. Re-burial of the contaminated material at greater depth elsewhere on the site may be possible where the area and the topography of the site allows this. This course of action requires knowledge of the future use of the land and, since asbestos is a controlled waste under the Control of Pollution Act 1974, the area proposed for its re-burial will normally require the issue of a licence by the relevant waste disposal authority: it may be necessary to impose restrictions on redevelopment of the site. The operation would also need to be carried out in accordance with the current recommendations on disposal of asbestos waste (1,2), which may include stipulations of the type and depth of cover (generally not less than 2m) required to permit the land to be restored. In situ encapsulation requires provision of an impenetrable barrier between the contaminated material and any future activities on the site.

XI COVERING

24. Asbestos present below the ground surface, though not buried at the depth that would be required by current disposal practice, does not always need to be removed or re-buried. Provided that the site can be left undisturbed and is not subject to weathering and erosion, it may suffice to maintain or slightly increase the existing depth of cover (12). Well-established and properly maintained vegetation can, in such circumstances, provide adequate protection (13). It is advisable to inspect the site periodically to check that the underlying material is not disturbed (eg by excavation for any purpose) or the vegetation cover damaged (eg by fire). The frequency of inspection depends on the status of the land and the likelihood of disturbance: land which is abandoned or out of use may need to be inspected more frequently than sites which still form part of the operational land of active industries. Where necessary, adequate warning notices and secure fencing should be provided to restrict access and deter trespassers. At some sites, the local authority may decide to carry out the inspections itself and undertake any immediate work required to protect the public; where the land is still in use the responsibility lies in the first instance with the land owner or user.

25. The long-term uses of such land may be restricted to those which do not necessitate subsequent excavation for any purpose: examples include playing fields, parks and amenity areas. Such sites should not be used for gardens, allotments or agricultural uses in which digging, ploughing or under-drainage may be involved; grazing land may also be subject to disturbance by ploughing for reseeding (see also para 28).

XII TREATMENT

26. Treatment of the asbestos by processing, either before or after removing it from its existing location, may enable subsequent disposal to be achieved more easily or possibly reduce the hazards sufficiently for retention of the material on the site to be reconsidered. The following physical and chemical treatment processes are currently available:

i Physical compaction: loose fragments of asbestos are collected and treated in a mobile plant which compresses and solidifies the material before sealing it in heavy-duty plastic sheeting or, as in another similar process, in steel drums. The blocks can then be handled and transported safely for disposal off site or re-burial elsewhere within the existing site.

ii Solidification: the contaminated material is mixed with cement or other suitable chemicals in order to produce a matrix which retains the individual fibres securely and prevents them from escaping into the air or the surrounding soil.

iii Vitrification: the material is mixed with glass cullet (scrap glass) or glass-forming material and heated to high temperatures (of the order of 1200°C) in a furnace so that the asbestos melts; on cooling the mixture forms to a dense glass-like material which does not contain fibres and is much higher in density than the original waste. The resulting product has potential for use as a construction material.

27. All of these processes have advantages and limitations; their application to a particular site depends on the nature of the contamination and must also satisfy the requirements of the Health and Safety at Work etc Act and other relevant legislation. Physical compaction is the most tolerant of the variations in form and composition likely to be experienced on contaminated sites. Solidification and vitrification are, in principle, capable of treating soil and sub-soil materials from which the asbestos could not easily be separated. However, both these methods require special plant and a source of energy, which in the case of vitrification could prove expensive if very large volumes of contaminated materials need to be processed. Treatment of contaminated soil or sub-soil by any of these processes will be more difficult if the material contains significant amounts of scrap metal or other bulky objects. Chemical treatments for destroying asbestos are under development. A discussion of the various treatment options is to be found in References 2 and 15.

XIII DEVELOPMENT

28. Advice on development of contaminated land is given in Department of the Environment Circular 21/87 (Welsh Office 22/87) Development of Contaminated Land (14). Retention of the asbestos beneath permanent hard cover in the form of buildings, roads, pavements, and parking areas is, in principle, an effective long- term method of dealing with the contamination which allows the land to be used for a beneficial purpose. Industrial or commercial buildings are preferable to residential developments on sites of this type. Whatever the purpose of the development it is essential to provide adequate protection for the construction workers and members of the public in the near vicinity, and to carry out site clearance and excavation in a way which minimises release of fibres to the atmosphere (see para 16).

29. Records of the contamination found and all actions taken with respect to disposal, retention on site, covering, treatment etc should be kept and cross-referenced to documents concerned with land ownership, planning, and land use.

XIV REFERENCES

1. DEPARTMENT OF THE ENVIRONMENT: Waste Management Paper No18 Asbestos Waste - A Technical Memorandum on Arisings and Disposal including a Code of Practice. HMSO 1979. ISBN 0 11 751384 9.

2. INSTITUTE OF WASTES MANAGEMENT: Code of Practice for the Disposal of Asbestos Waste. October 1988. ISBN 0 902944 17 7.

3. The Control of Asbestos at Work Regulations 1987 (SI 1987 No 2155) ISBN 0 11 078115 5.

4. HSE: Approved Code of Practice: The Control of Asbestos at Work Regulations 1987. (COP 21). ISBN 0 11 883984 5.

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6. HSE: A guide to the Abestos (Licensing) Regulations 1983. (HS(R)19(Rev)). ISBN 0 11 8854895.

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9. The Release of Dispersed Asbestos Fibres from Soils. Technical Memorandum TM/88/14. Institute of Occupational Medicine, Edinburgh, September 1988.

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14. DEPARTMENT OF THE ENVIRONMENT: Circular 21/87 (Welsh Office 22/87) Development of Contaminated Land. HMSO. 1987.

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