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Soil quality — Sampling —

Part 3: Guidance on safety

Qualité du sol — Échantillonnage —

Partie 3: Lignes directrices relatives à la sécurité

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare Internatinal Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 10381 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10381-3 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 2, *Sampling*.

ISO 10381 consists of the following parts, under the general title *Soil quality — Sampling*:

— *Part 3: Guidance on safety*

— *Part 6: Guidance on the collection, handling and storage of soil for the assessment of aerobic microbial processes in the laboratory*

Additional parts are in preparation.

Introduction

This part of ISO 10381 is one of a group of International Standards intended to be used in conjunction with each other where necessary. ISO 10381-3 deals with safety for various purposes of soil investigation.

Soil quality — Sampling —

Part 3: Guidance on safety

1 Scope

This part of ISO 10381 provides guidance on the hazards that may exist during a site investigation and when collecting samples of soil and other ground material, including hazards that are intrinsic in the sampling operation in addition to the hazards that may arise from contamination and other physical hazards. Precautions are given so that the risks involved in any sampling or site investigation can be controlled and minimized.

This part of ISO 10381 gives guidance on hazards which may be encountered in a site investigation

— in general,

— on agricultural areas,

— on contaminated areas,

— in geological investigations,

and an indication of the activities which may give rise to risks. It then describes procedures which may be adopted to control risks.

This part of ISO 10381 is designed specifically to deal with the problems of safety during sampling and site investigation, and is not intended to provide guidance for other situations such as construction.

NOTE Former production sites for munitions and other warfare agents present special problems to investigators and others involved in handling samples collected at such locations. The guidance given in this part of ISO 10381 will be of assistance in these situations, but additional guidance on the precautionary measures to be taken should be obtained from the specialists responsible for the former operation of these sites.

2 Preliminary procedures

In all daily activities there is an element of risk and this risk is increased when the environment is unfamiliar. Even sampling an agricultural area involves an increased risk to the sampler, because the nature of the ground and possible hazards are not necessarily known to the sampler.

When examining a site for contamination, the risks are increased, due to the presence of chemicals, compounds and agents which present a hazard to human health. When examining a former industrial site, the risk of physical injury can be increased because of the possibility of voids and cavities (physical hazards) beneath ground level which may not have been properly filled in. Cavities may also be present where there has been underground combustion (for example in refuse sites and colliery waste disposal sites).

Physical injury is also possible in any sampling situation where machinery is being used; this applies to agricultural sampling as much as to contaminated-site investigations. Possibly the injuries could be more serious in a contaminated-site investigation because bigger and more powerful machines are involved, and even minor injuries may provide a pathway for toxic substances and pathogens to enter the body.

Care should also be taken to ensure the safety of the investigator when a preliminary site visit (site reconnaissance) is carried out prior to commencing the full site investigation, particularly as all potential hazards may not have been identified at that time.

The main objectives of this guidance on safety are

a) to identify the hazards that may exist in carrying out site investigations and soil sampling programmes,

b) to indicate management procedures to provide a framework for safe working and proper response in the case of accident,

c) to indicate what precautions can be taken in terms of personal protection and cleaning facilities to minimize any hazard, and

d) to indicate what working procedures can be adopted to minimize hazards from contaminants and physical hazards associated with the collection of samples and the use of machinery.

3 Concepts of hazards, risks and safety

It is not possible to identify all the hazards which may be encountered during site work, nor to provide guidance on how the associated risks may be dealt with in all situations. Safety depends ultimately on the adoption of an attitude and approach to any particular situation which will ensure that the hazards are identified and properly evaluated, and appropriate precautions taken.

Those authorizing, designing and supervising works, the employers, and those carrying out the work all have a joint responsibility for safety. This responsibility extends beyond the workforce to include the general public, who may be living or working close to the site to be investigated, or who may enter the site with or without permission while the works are in progress.

The guidance in this part of ISO 10381 should be read in conjunction with relevant national and international legislation and regulations regarding health and safety at work.

In general, achievement of safe working conditions requires the employing organizations to adopt formal “policies” and operating frameworks which will require and permit

— identification of hazards and evaluation of risks,

— avoidance of risks wherever possible,

— failing this, control of the risks through adoption of appropriate operating procedures, and

— failing this, or in addition, the protection of individuals against unavoidable risks.

It is necessary to provide training, to keep records of procedures adopted and of any incidents. It may be necessary to establish health screening and surveillance programmes.

In these ways it should be possible to reduce risks to an acceptable minimum.

In order that appropriate risk reduction and management procedures can be identified, it is necessary, on a site-specific basis, to

— identify hazards,

— identify under what circumstances the hazards may present a risk,

— quantify the actual risks.

In relation to contaminated sites, the importance of a desk study for identification of hazards from contamination and physical conditions must be emphasized.

4 Exposure of personnel to hazards

4.1 General

This clause deals with the way in which hazards present at a site may affect the investigators.

Different types of hazards have been identified as occurring in different situations. These can result in a range of effects, varying from skin irritation and simple physical injury to death. When establishing suitable safety procedures not only must the hazard be considered, but also the way the hazard is likely to be encountered by the investigator or sampler. In most cases the hazards are due to acute toxic effects but, in the case of regular investigators and samplers, chronic toxicity is a possible hazard.

4.2 Exposure by contact

Direct contact with chemicals such as chlorinated solvents, benzene, tars, oils and greases, phenols, chromium(VI) compounds, pesticides (e.g. insecticides, herbicides, fungicides) and many others can result in effects on humans. These effects can result in the development of skin rashes or irritation and other dermal effects and, where absorption occurs, more serious effects may result.

Some chemicals are potentially carcinogenic through skin contact.

The degreasing effect of solvents and oils also reduces the ability of the skin to prevent absorption of compounds and to prevent infection.

Some chemicals can be absorbed through the skin with adverse effects if the contact is sufficiently prolonged or of sufficient concentration. If the skin is broken due to cuts or abrasion, then absorption occurs much more readily and bacterial infections can be caused very easily, e.g. tetanus and suppurations. Weil's disease can be transmitted through breaks in the skin but the causative organism (*Leptospira*) can actually penetrate the skin if it is softened by prolonged exposure to water.

The eyes can suffer from contact as a result of splashing when dealing with liquids and wet material, and also by transfer from dirty hands, gloves or other articles of clothing. The eyes can suffer from irritation which may clear up as a result of bathing, but particulate matter may cause scratching and solvents can cause permanent damage.

4.3 Exposure through ingestion

Contaminants from a site can be ingested by eating food, smoking, taking refreshment or even careless wiping of the face with hands or gloves which have been dirtied with contaminated material.

Because the mucous membranes are generally more sensitive than skin, much less contamination is required to cause an adverse reaction. If contaminated material is inadvertently swallowed, then stomach upsets, infections and other short-term effects can ensue. It is also possible that ingestion will lead to more rapid absorption of toxic material and can also result in longer-term adverse effects.

4.4 Exposure through inhalation

The presence of gases and vapours can cause a variety of effects ranging from headaches to death, the degree of severity depending upon the toxicity of the chemical and the severity of the exposure. Carbon dioxide and hydrogen sulfide both cause the above range of reactions. Solvents and similar compounds can give rise to narcotic effects.

The effects caused by some compounds can be enhanced where the inhalation is a result of smoking, since the heat of the tobacco can cause the formation of breakdown products more toxic than the original fumes, for example chlorinated solvent vapours are converted to carbonyl chloride ($COCl_2$ phosgene) by the heat of a cigarette.

Exposure can also occur through inhalation of dust, fibres and fumes. The hazard from dusts may be due to different effects. For example, silica and asbestos are not active chemically but can be dangerous when inhaled. Other dusts which contain polyaromatic hydrocarbons or dioxins can cause cancers, while other chemicals can have toxic effects.

Exposure by inhalation can arise from the sampling process (e.g. inhalation of the exhaust fumes, or dust from drilling concrete), rather than from contaminants within the site.

The effects of exposure by inhalation varies; with some compounds the effects can be readily reversed by removal from exposure, while in other cases more serious long-term effects result, requiring a much longer recovery period.

4.5 Exposure to physical hazards

Physical hazards can range from simple damage to limbs and joints, as in sprains and broken bones, through to more serious injuries due to being hit by excavators or falling on equipment such as augers. Unstable ground around excavations, boggy ground and bodies of water can result in physical injury, ingestion of contamination material, and possibly in drowning.

Excavations, such as trial pits, are not normally entered during a site investigation but where entry is necessary, a hazard is present due to possible collapse of the sides. This becomes a serious hazard when the excavation is greater than about 1,2 m deep.

Excavations also present a hazard to personnel at ground level if the sides are not stable, due to the possibility of collapse into the base of the excavation, the hazard increasing with increasing depth and decreasing stability of the ground.

4.6 Exposure to fire and explosions

The presence of underground fires can present a hazard due to the formation of underground cavities, breakout of flames and the formation of toxic gases, including carbon dioxide and carbon monoxide.

The presence of flammable and explosive gases in situations such as landfills and underground tanks can present a hazard, particularly if some form of ignition is inadvertently provided.

Use of explosives may be necessary in very hard ground situations (for example in permafrost regions).

The presence of unexploded bombs and mines, etc. from former wartime activities can also present a hazard. Hazards due to explosives residues and munitions are likely to exist at sites which have produced and handled explosives and munitions.

5 Potential on-site hazards relating to sampling and the area of investigation

5.1 General

This clause describes the hazards that may be presented by different contaminants and physical aspects during the course of site investigations and sampling.

This part of ISO 10381 does not seek to address everyday hazards that may arise from the use of such items as sharp instruments, digging equipment such as forks, nor the hazards of driving to a site location. It is assumed that such hazards are satisfactorily dealt with by the personnel carrying out the investigation and the sampling.

5.2 General hazards

5.2.1 Hazards due to solid and liquid chemicals

These may be very obvious (as in the case of chemicals remaining on a former industrial site) or may not be apparent (for instance in the case of pesticides in a field). When devising a safe method of investigation and sampling, both situations have to be considered and precautions taken.

The hazard may be presented by direct contact due to lack of protective clothing or contact through transmission by hands. Where dusts are formed, inhalation can occur. Where wet conditions exist or there are liquids, inadvertent contact due to splashing is possible.

5.2.2 Hazards due to gases

Since most site investigations are carried out in the open air, hazardous concentrations of gases rarely develop due to dilution by the atmosphere. However there are recorded cases of drilling crews being overcome by fumes and being hospitalized, thus caution should be exercised when assessing the potential hazards.

It is possible, in particular situations (where there is active anaerobic degradation and substantial methane generation, for example in landfill sites), that dilution of the gas by the atmosphere could bring the concentration of methane to within the explosive range.

In other situations, although dilution by the atmosphere prevents exposure to hazardous concentrations, lower concentrations of gases can still cause symptoms such as headaches, runny eyes and are thus undesirable.

Use of machinery with closed unventilated cabs can lead to the development of toxic atmospheres which under extreme conditions can be fatal.

The exhausts of internal combustion engines emit fumes which can present a hazard.

Where the investigation requires entry into deep excavations or confined spaces, particularly those below ground level, the build-up of explosive and/or toxic gases and the formation of an atmosphere which is deficient in oxygen is a possibility. An atmosphere deficient in oxygen even by a small amount (1 %) can be fatal.

5.2.3 Hazards due to biological causes (bacteria and viruses)

Although accidents due to biological reasons rarely occur, there is a potential for illness due to the widespread nature of bacteria and viruses. These illnesses need not be fatal and may not necessarily be diagnosed as associated with the work that has been carried out. Because of the widespread distribution of bacteria, it is worthwhile considering the hazards that they may present and also taking precautions to prevent any adverse effects from them, however mild.

Some biological hazards are not site-specific (e.g. tetanus, typhoid and Weil's disease) and require appropriate general precautions in addition to any local prevention.

Weil's disease (*Leptospira* jaundice) occurs as a result of contact with water which has been contaminated by rat urine (see 4.2). Any outdoor body of water may therefore be a source of hazard, as can areas where there has been a high rat population, for instance landfill sites. Infection by *Leptospira* can be fatal if not diagnosed at an early stage.

The presence of anthrax spores can also present a hazard (see 5.3.4).

5.2.4 Hazards due to radiation

Radiation hazard is not usually very great in any normal site investigation or sampling exercise. The presence of a radiation hazard due to previous operations at a site should be identified by the desk study. With any site investigation, the transient nature of the exposure should ensure that harmful radioactive dosages are not received, but the need for precautions and personnel monitoring should be considered.