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GROUNDWATER CONTAMINATION FROM LEAKING HOME HEATING OIL SYSTEMS

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The storage of home heating oil on private residential property is widespread and common in Ireland but in recent years there has been a noticeable increase in the number of tank and line leaks and as a result significant volumes of oil are often released to the subsurface. These releases can have a detrimental effect on both the local environment and property values while also disrupting everyday life in the home. The "solution" in the past has been to treat the symptoms and to ignore the problem. However this reactive approach is no longer acceptable to our increasingly litigious and environmentally conscious society. To better serve the home owner's interests, a more comprehensive procedure is needed whereby a set of proven and site-specific remedial actions are prescribed in the event of a heating oil leak. Both the building industry and home owners need to be informed as to the seriousness of the current situation and the relatively simple preventative measures that can be taken to avoid its continued occurrence. Prevention is seen as the only secure policy for the future.

THE BACKGROUND

Whether they realize it or not, home owners with oil storage tanks have put themselves in the unenviable position of storing several hundred gallons of a highly flammable and toxic chemical on their property. If this chemical escapes to the ground it can migrate both laterally and vertically to cause a host of detrimental effects both on the homeowner's property and that of his neighbors. The unsuspecting home owner does not have to apply for a licence to take on this onerous liability, neither is there any equipment certification process nor manufacturer's maintenance schedule to meet. Every home owner with an oil-fired system is expected to become an expert in oil storage from day one without the benefit of any form of training.

Although available since the 1950's, oil-fired domestic heating and cooking systems have proliferated in recent years. The basic system being installed today comprises a burner coupled by a narrow diameter pipeline to an above-ground oil storage tank. Today the grade of oil on the market is limited to kerosene or diesel although in former years medium grade and even heavy fuel oils were generally available.

The oil-fired systems are relatively economical to operate, require little maintenance, and are flexible enough to meet most household needs. Installation of the system requires little or no expertise and is often undertaken by the local plumber or handyman.

The logical location for the oil tank is to the rear of the house, out of sight and close to the burner itself. Heating oil is readily available from local merchants throughout the country and can be delivered rapidly. All delivery tankers now have a reasonable length of flexible dispensing hose that can reach even the most inaccessible domestic tanks.

THE PROBLEM

The problem begins when a significant quantity of oil is released in an uncontrolled fashion. This usually happens when a leak develops in either the tank or the connecting pipeline. However uncontrolled releases have also been known to occur during refuelling for a variety of reasons, most of them avoidable. Slow leaks are especially difficult to detect and it can take some time before a symptom manifests itself which is recognizable by the home owner.

Corrosion is the most obvious reason behind a leak developing in a tank or pipeline but there are a host of others as will be discussed later in this section. In the case of mild steel tanks the corrosion is rarely perceptible from external appearances and is generally more developed on the interior surface of the tank due to the constant condensation and evaporation of water vapor above the surface of the oil as a result of diurnal temperature changes. These susceptible interior surfaces are virtually inaccessible and no amount of external tank maintenance such as repainting will postpone their eventual failure. Typical failures can occur after about thirty years but are dependent on variables such as the gauge of steel used and the exposure of the tank to frequent temperature changes.

Underground tanks are less susceptible to such temperature changes but even these generally have a maximum life expectancy of less than forty years, and some have been known to corrode in less than twenty five years. Soil acidity and the action of static electricity are recognized as having a major role to play in the corrosion of underground mild steel tanks.

The plastic tanks that are now on the market are also vulnerable to failure. At least one manufacturer in Ireland has produced tanks which are especially prone to leakage. A recent court case laid the blame at the door of the mould manufacturers but this is scant comfort for the home owner

especially when he has been given the reassurance that all tanks are certified as having been pressure-tested prior to delivery. The lifetime of plastic tanks is not yet known but on some of the early tanks the surfaces which are constantly exposed to sunlight (ultraviolet) begin to turn opaque after a few years and subsequently desiccate and become brittle. A realistic lifetime of these plastic tanks is therefore anticipated to be of much the same magnitude as the mild steel tanks. Two other phenomena to which the plastic tanks offer even less protection than the mild steel variety are fire and vandalism. For these reasons mild steel tanks continue to be the preferred choice for industrial applications.

The pipelines linking the oil storage tanks to the burner units have proven to be even more susceptible to leakage than the tanks themselves. Until relatively recently half-inch mild steel pipe has been the preferred choice although in some cases even lighter copper pipe has been employed. These pipes nearly always act as the electrical earth for the mild steel tanks and are thus continuously exposed to a mild form of electrolysis which can accelerate corrosion. However where lines have been lagged with a chemically resistant coating such as bitumen or Teflon^{TM} they are generally adequately protected. Unprotected pipes which are laid in acid soils or concrete have been shown to be especially susceptible to corrosion and in some cases no trace of the original oil pipe remains by the time the leak is investigated.

A relatively recent development has been the introduction of Teflon^{TM}-coated copper piping which is expected to be at least as resistant to corrosion as the bitumen-lagged mild steel piping. Unfortunately the Teflon^{TM}-coated piping can be severed by a simple garden spade and is thus extremely vulnerable. Furthermore the Teflon^{TM} coating is easily scored by careless installation so as to expose the metal, and small animals appear to consider Teflon^{TM} a particular delicacy!

More recently there have been several cases where pipe joints or unions have been identified as the source of leaks. This particular phenomenon is manifesting itself mainly on new housing estates and can usually be ascribed to under-tightening or cross-threading of the pipe fittings.

THE IMPACT

Heating oil leaks are generally only reported when their impact is sufficiently detrimental so as to require some form of remedial or containment action. Home heating oil tanks rarely exceed 1,350 liters (300 gallons) but, if the oil were to be uniformly distributed in the subsurface, the total loss of a single tank could theoretically contaminate 270,000 kilograms of soil or 227 million liters of water to a concentration in excess of the Dutch intervention values.

When oil escapes it moves under the effect of gravity and percolates vertically where the ground surface is permeable. It will preferentially follow the line of least resistance such as that created by foundations, wall footings, or recently dug ground. The oil will continue to attempt to percolate under the influence of gravity until the effect of surface tension created in the soil column is such that it balances the weight of the oil acting on it. The surface tension effect is inversely proportional to the size of the permeable soil matrix which basically translates into rapid vertical movement in a coarse-grained matrix such as gravel and less penetration at a slower rate in a fine-grained sand or silt.

For obvious reasons sudden heating oil losses are usually noticed by the home owner fairly quickly. However the slight increase in oil consumption caused by a slow leak is virtually imperceptible and the gradual movement of the oil through the subsurface may delay the observation of any symptoms for some time. Some of the symptoms which have been reported in connection with heating oil losses are as follows:

- scorched grass and/or dying vegetation;
- complaints from the neighbors;
- dead earthworms, amphibians, and birds;
- strange odors (both indoors and outdoors);
- funny taste in the water or food (sometimes oil droplets);
- dry scaly skin (like eczema);
- headaches and/or stomach sickness;
- oil burner keeps cutting out due to air-locking;
- unusual oil usage.

All these symptoms can translate into a sterile (dead) garden, a house with errant oily odors, a polluted well and water system, and a lawsuit from the neighbors who may have suffered the same consequences. Aside from the cost of the lost oil, the cleanup, and the tank/pipeline replacement, one must consider the gross inconvenience suffered by the home owner, his family and other affected parties. If a cleanup is necessary, additional disruptions will occur when the contractors begin remediation and in certain cases the entire ground floor of the house has had to be excavated effectively rendering the house uninhabitable for the duration of the cleanup.

Even these costs and inconveniences pale into insignificance when the potential loss of market value for affected properties is taken into consideration.

REMEDIAL ACTIONS

Each heating oil loss has its own particular set of circumstances and requirements and in no way does this paper purport to act as a cleanup manual although some of the following information contained herein may prove useful in understanding the situation.

Immediately a heating oil loss is suspected by the home owner the insurers should be notified. In the event that further advice is needed, either the Environmental Officer in the local authority or the environmental information service ENFO can provide a list of specialists in this field.

It is essential before deciding on a course of remedial action to establish the maximum potential volume of heating oil lost and the period of time over which the loss occurred. Upon being notified of the loss a person with experience of heating oil cleanup should undertake a site visit and an interview of the affected parties as soon as possible. The urgent need for an assessment of the situation is often overlooked and the incident is treated in much the same way as a claim for a burglary or car accident. However, whereas the event of a burglary or car accident occurs at a specific time, in the case of a heating oil loss the damage continues to accumulate after the loss as the oil migrates through the subsurface and for this reason quick action is especially important for the purposes of damage limitation. The following is a list of some of the remedial actions which are commonly needed during cleanup:

- contaminated soil excavation, removal, and replacement;
- plume containment using pump and treat techniques;
- well abandonment and replacement (siting and construction are especially important);

- detergent wash and rinse of household water system following draining (including water appliances);
- excavation of an interceptor trench across the path of oil migration;
- chemical and bacteriological treatment of the subsurface;
- application of an indoor positive pressure system to eliminate vapors;
- groundwater sampling and analysis;
- tank and pipeline replacement including double containment.

The most effective action which can be taken is containment. If any of the oil-saturated soil is easily accessible it should be excavated and placed in an area which is both covered and contained. Too often however the oil has seeped to below accessible depths and may lie adjacent to structural foundations. Strictly speaking advice from a structural expert should be sought before any deep excavation is undertaken within 5 meters of building foundations.

In rural areas the house is often supplied by its own well. If there is any chance that the well has been compromised the water must not be used for drinking or cooking purposes. If there is no oily odor from the water when it is boiled, it can be safely assumed that the oil content is sufficiently low (<1 ppm) so as to allow the water to be used for all other household purposes including bathing. The oil may appear intermittently however and it is essential to test both the water directly from the well and that supplied via the attic tank. Infants and small children are especially sensitive to water quality and, if there is any doubt, it is preferable to err on the side of extreme caution. Also remember that nearby wells may be affected and that those property owners have a right to know if their well may be affected.

THE COST

Cleanup costs for serious home heating oil leaks or spills are likely to exceed a figure of pounds sterling (£) 1,000 under most circumstances. Where extensive damage has occurred, which affects for example a row of terraced houses, cleanup costs have regularly been known to exceed£ 100,000.

In most reported cases the home owner is not personally liable for the cleanup costs. If the property is insured, coverage may be provided for under a sudden and accidental environmental damage clause. If the fault is one of poor installation, the company which installed the tank should have their own coverage. If the tank or line has been recently installed and has failed, then the tank suppliers may be liable. If the leak occurred on an adjoining property then the respective insurance companies should be in a position to agree liability.

Even if the worst scenario is realized and the home owner must pay for the assessment and cleanup out of his own pocket, it is still strongly recommended that proper specialist expertise be sought. A few minutes of telephone advice and, if possible a site inspection, could avoid unnecessary expense and possible later repercussions.

PREVENTION

Many attempts to reduce the vulnerability of home heating oil storage tanks and lines to leakage have been practiced in the past. Plastic tanks are only the latest attempt at improving home heating oil storage systems while keeping costs down. Cathodic protection using an electric field to counter corrosion was seen as the answer in the 1960s but fell prey to maintenance problems in the long term.

The Teflon™ coated copper pipe was also a step in the right direction but, as pointed out earlier, still has its disadvantages.

Double-containment has universally been accepted as an effective solution to the problem of leaking oil tanks at industry level and is now an accepted world wide standard. Double-containment of above-ground oil tanks is also a prerequisite under the IPC licensing system and could easily be adapted to suit home heating oil storage systems. The tank, whatever its construction, is placed within a purposely-constructed bermed area. The entire length of Teflon™ coated pipeline is sleeved with a protective plastic outer cover and preferably routed over ground. Although unavoidable accidental heating oil releases will undoubtedly continue to occur, if these simple construction techniques are adopted, it can be expected that the number of home heating oil losses will be greatly reduced.

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