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apropos

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General	Fuel stations have been around since the internal combustion engine was first invented. They include not only the familiar public filling stations but also private fuelling facilities run by industrial fleet operators, small- and medium-size enterprises, and local authorities. Because of the environmental hazards they pose, fuel stations have recently come into the focus of public attention. This is no doubt due to the fact that the link between the fuels and other consumables handled and potential environmental pollution is particularly apparent; and in fact the probability of encountering soil, ground air and groundwater contamination in the vicinity of fuel stations is high. Experience shows that a conventional filling station leaks on average 400 litres of fuel into the subsoil per year just in the course of normal operation – accidents not included. The pollutants involved are mainly petrol and diesel fuels but also used oil, chlorinated hydrocarbons (CHCs) and heavy metals. The following statutory regulations, water conservation and industrial codes and requirements are applicable in Germany: o the Filling Stations Ordinance (TRbF 112/212); o the Ordinance governing Facilities for Handling Water-Hazardous Substances and Specialised Operations (VAwS); o the Ordinance governing Facilities for the Storage, Dispensing and Overland Conveyance of Combustible Fluids (combustible fluids ordinance VbF); o the Water Resources Management Act WHG Art. 19g defines fuel stations as facilities for dispensing potentially water-polluting substances; o the requirements of the Water Resources Management Association of the Federal States (LAWA) applicable to dispensing facilities at fuel stations; o the Ordinance on the Limitation of Hydrocarbon Emissions during the Transfer and Storage of Spark-Ignition Engine Fuels (20. BImSchV; introduction of the gas displacement fuel transfer method); o the Ordinance on the Limitation of Hydrocarbon Emissions during the Fuelling of Motor Vehicles (21. BImSchV; introduction of the aspirating-tube nozzle).
Potential causes of pollution	Typical sources of contamination associated with the operation of fuel stations are: – dripping during fuelling operations and vehicle workshop activities; – fluid escaping through loose flanges or from leaky pump bodies or separators; – damage to underground fuel lines due to subsoil subsidence; – escapes through leaky joints and service pits; – overfilling and damage during filling; – accidental discharges from oil tanks or defective tankers; – leaks from used-oil receptacles.
Analysis of the risk	A detailed study should investigate the site history, the locality, and the geological and hydrological conditions at the site. The latter involves making probes, including soil, ground air and groundwater sampling. The construction planning documents and civil engineering aspects should also be reviewed – preferably on the premises themselves.
Site history, locality	This part of the study determines the extent to which the site is polluted from previous or long-standing operations and whether there are other fuel stations or other emitters with a similar pollutant spectrum in the vicinity.
Geological and hydrological conditions	Study of the subsoil is essential to evaluating the scale of damage suffered and determining the effort required to clean up the site. It is important to be familiar with the structure of the subsoil, the rock composition and the groundwater conditions.

Probes

The geological and hydrological conditions are investigated with the aid of probes. Care must be taken when driving probes not to damage underground lines or tank facilities. A section diagram to DIN is drawn up on the basis of the drill core. The probe material and the groundwater can be analysed to gain further information.

To avoid the risk of probe drills connecting up separate groundwater strata, all drill holes are carefully sealed.

Sampling

From each metre of drill core, a composite sample is taken and used to determine the quantities of the various contaminants present. If high pollutant concentrations are found, separate soil samples are taken. The ground air is analysed for the presence of fuel vapours and, if considered necessary, CHCs.

Groundwater samples are stored under cool conditions in light-proof containers pending analysis in the laboratory. If necessary, back-up samples are set aside.

Construction planning documents

The documents drawn up for the construction permit application provide an insight into the physical configuration of the fuel station, in particular the underground tank facilities and piping systems.

Civil engineering aspects

The civil engineering design is the starting point for further investigation of the premises on which the fuel station stands. Review focuses on the following criteria:

- o leaktightness of the tanks including supply and extraction lines;
- o adequate dimensioning of the filling area;
- o separation of the filling area from the rest of the station;
- o catchments and drainage provisions in or beneath the dispensing facilities;
- o routing of drains;
- o catchment basins for leaks;
- o oil separator systems;
- o roofed-over areas;
- o sealing of pavement, including grooves;
- o service pits;
- o filling points.

Possible contents of a risk analysis

The results of all investigations are incorporated into the analysis report, which generally exhibits the following structure/sequence:

- o assessment of the risk situation;
- o review of the as-built configuration;
- o description of the geological and hydrological situation;
- o description of the premises studied;
- o conditions/requirements imposed by the authorities;
- o identification of the maximum possible scale of damage;
- o recommendations for clean-up and rehabilitation;
- o description of the decontamination technology to be used;
- o determination of the probable cost of clean-up and disposal.

Possible decontamination methods

The procedures to be applied in the clean-up of fuel stations depend on the types of contamination present.

The following contaminants may find their way into the soil and groundwater from the operation of fuel stations: hydrocarbon compounds, especially mixtures containing aromatic hydrocarbons such as benzene, toluene, ethyl benzene or xylene. If other activities are performed on the fuel station premises over and above normal fuelling operations, the following contaminants may also be present:

- o polycyclic aromatic hydrocarbons;
- o chlorinated hydrocarbons;
- o polycyclic biphenyls;
- o tensides;
- o heavy metals.

The following techniques can be used to decontaminate the soil:

Ground air extraction

The ground air extraction method is especially suitable for removing benzene, toluene, volatile alkenes and CSCs from the soil. For this method to be successful, the subsoil needs to be readily permeable to air.

The technique involves using an air suction system to create a vacuum in the soil. The pollutants entrained in the extracted air are captured in an activated-carbon filter.

Biological decontamination

The biological decontamination method is used primarily to combat pollution by spark-ignition-engine and diesel fuels. Micro-organisms such as fungi or bacteria feed on the hydrocarbons contained in the fuel, digesting them almost completely into environmentally-neutral water (H_2O) and carbon dioxide (CO_2). This biological clean-up works only if the following conditions are fulfilled:

- suitable temperatures and soil structures;
- adequate moisture and suitable pH;
- accessibility of the pollutants for biological conversion;
- adequate supply of oxygen and nutrients to the micro-organisms;
- no bactericide substances in the soil.

As a rule, the contaminated soil is excavated and treated under controlled biological conditions in containers or stockpiles. To accelerate pollutant decomposition, the soil is regularly re-mixed and seeded with nutrients and micro-organisms. On completion of the purification process, the soil can be returned to the ground.

Soil scrubbing

Soil scrubbing techniques are used less frequently than the aforementioned methods and take a lot of effort. They involve first excavating the contaminated soil and usually carrying it to permanent scrubbing installations where the scrubbing and cleaning procedures are performed using water and additives such as tensides to mechanically wash the pollutants out of the soil. The finest particles of the soil are washed out at the same time.

The soil scrubbing method is not universally viable, not being able to remove all pollutants and being suitable only for certain types of soil structure.

Thermal purification

Thermal purification is a last resort, used when the customary procedures for decontaminating soil do not produce the desired results. It involves incinerating the typical fuel station pollutants out of the soil. The disadvantage of this method is that soils treated in this way are biologically dead and have to be organically regenerated.

The treatment is performed in rotary kilns.

Decontamination of groundwater

The procedure for cleaning up groundwater pollution is as follows:

- application has to made to the competent authorities for permission under water conservation regulations; permission is granted on the basis of an expert's opinion report;
- wells are sunk;
- pumps are installed;
- the contaminated groundwater is cleaned;
- the decontaminated groundwater is discharged.

All results achieved by decontamination must be documented and submitted to all parties involved in the form of interim reports. The insurer should follow the progress of remediation on the basis of his own experience or if necessary with the assistance of external experts.

Remediation efforts generally continue until the water quality criteria and targets specified by the authorities have been fulfilled. In exceptional cases, for instance if geological conditions are particularly difficult, agreement can as a rule be reached with the authorities for the remediation measures to be discontinued as soon as the maximum improvement reasonably possible under the circumstances has been achieved.

Modernisation and rehabilitation of fuel stations in line with the state of the art

Rehabilitation work is generally performed when the fuel station is to be converted or refurbished anyway. After rehabilitation, the fuel station should be modernised to bring it into line with the state of the art. This may involve:

- laying non-settling, non-deforming base courses of poured-in-place concrete or asphalt;
- laying pollutant-proof pre-cast concrete blocks or slabs;
- sealing the subsoil and ensuring the leaktightness of joints;
- installing twin-walled underground tanks with leak monitors;
- installing a controllable piping system and performing annual leaktightness checks;
- providing collision guards for fuel pumps;
- roofing over the fuel pumps and all above-ground tanks;
- providing catchment bays, e. g. for storage of small containers;
- installing aspirating-tube nozzles;
- installing oil and fuel separators for filtering surface water;
- pollutant-proofing the repair and service areas;
- using only stainless-steel bays for storing de-greasing agents and other substances containing CHCs;
- using these substances only above CHC-resistant surfaces;
- posting safety pictograms, e. g. to advise of explosion hazards, "no smoking" signs.

Tips for the underwriter Liability insurance

Most fuel station sites will already have suffered pollution from everyday operation. This constitutes a hazard to the soil, ground air and water. Once the site has been cleaned up and upgraded to the state of the art, the risk due to normal operation recedes and the accident risk prevails. From the commercial liability aspect, special attention should be paid to the operation of vehicle servicing facilities, paint shops and car washes.

Many filling stations also sell food or consumer items. This should also be taken into account with respect to liability implications.

Gases are frequently present on site, whether for distribution as fuel for vehicles or to meet the fuel station's own energy requirements. An accident involving gases can cause injury and property damage.

Private fuelling facilities (operated e. g. by agricultural enterprises or oil refineries) may present an elevated risk potential.

Property insurance

Because of the types of substances present at fuel stations, the fire and explosion hazard is extremely high. The outbreak and spread of fires can be further precipitated by the presence of inflammable goods and materials and the need to use volatile liquids such as cleaners' naphtha. The packaging of the goods on sale also constitutes a major fire hazard.

Nevertheless, the material damage risk – by contrast with the third-party liability risk – is easily managed. The Property insurer can control the risk by means of instruments such as regular inspections and a damage prevention programme, and by heightening the fuel station operators' awareness of the problems involved.

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