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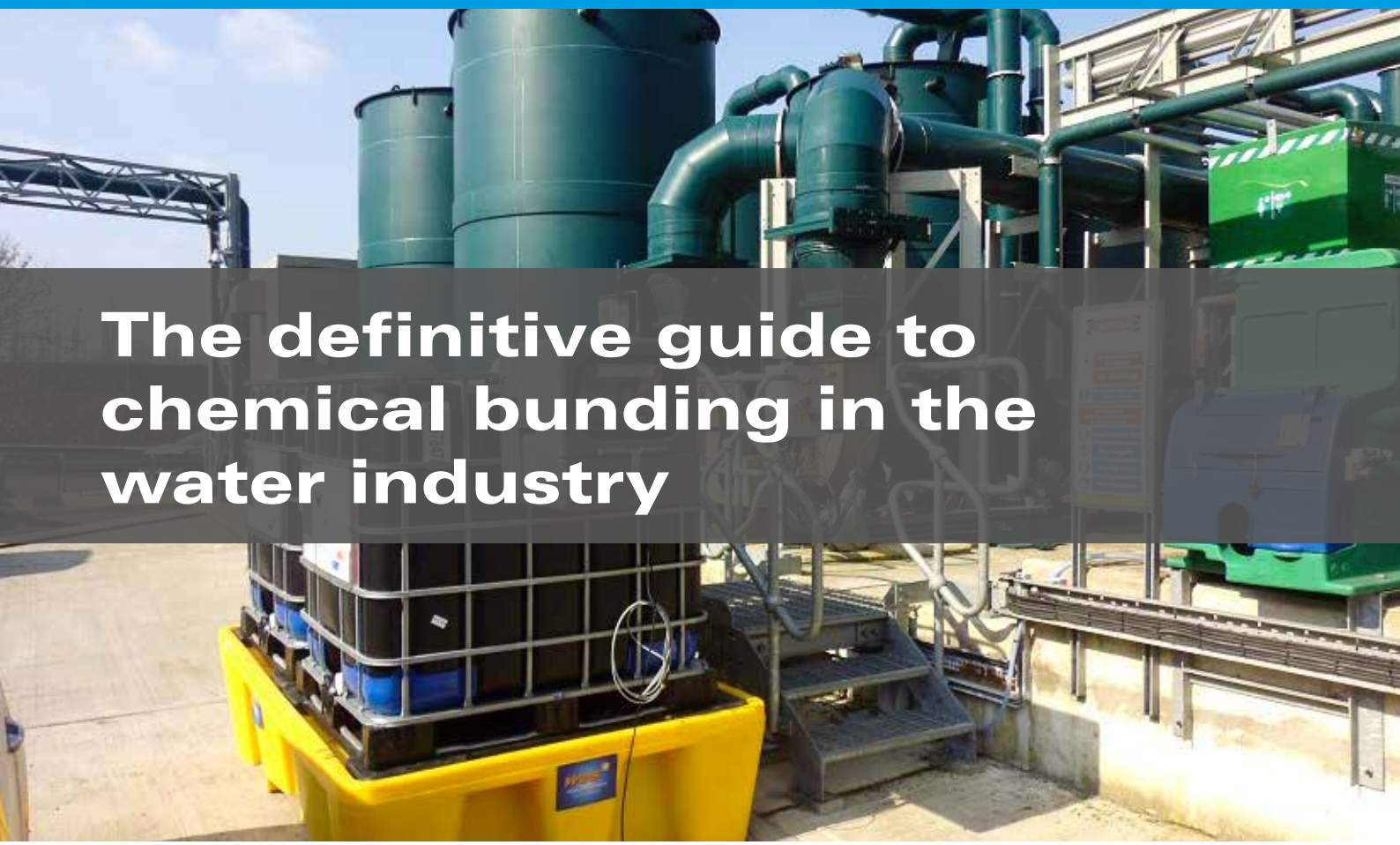


The definitive guide to chemical bunding in the water industry

For businesses involved in water and wastewater treatment, bunding is an essential element in preventing leakage of stored chemicals and protecting the environment. This white paper will explain the necessity for chemical bunds, examine the choices available and highlight the responsibilities of businesses toward their provision and maintenance. It will conclude with advice on how to achieve certainty with respect to bund selection.

It focuses specifically on chemical storage bunds in the water industry. Rules on bunding in the chemical manufacturing or petrochemical sectors, for instance, may be different in some key respects. An online search for 'bund' may bring up advice relevant to those industries or even to confinement of large water bodies, which can be confusing. Within the water and wastewater sector there are other uses for bunds, in tanker unloading or in containment of dosing cabinets and lines, for example. These are also outside the white paper's remit, which is strictly to advise on chemical storage.

A definition

A chemical storage bund can be described simply as a structure which underlies and forms a wall around an area containing hazardous chemicals or liquids. Its purpose is to provide secondary containment in the event of a leak. It prevents the spread of leaking liquids and so gives operators time to find and remedy a leak's cause. Bunds are needed for storage tanks, IBCs (intermediate bulk containers) and stored drums.

Bund categories

Permanent bunds are either built directly on the treatment site or manufactured off-site, transported and then permanently installed. Those enclosing free-standing storage tanks are normally designed into a plant's layout with due consideration of their future inspection, cleaning and maintenance needs.

Temporary or portable bunds, used for smaller volumes, are made from lighter materials. They include IBC bunds, which when constructed for movement by forklift trucks are often referred to as pallet bunds. Chemical dosing plants supplied as packaged solutions often have an integrated bund which may also form the base structure and support a kiosk-type cover.

Pallet bunds conveniently protect against spillage from IBCs or drums during transport and continue to provide bunding wherever the containers are stored. Strictly speaking, IBCs are delivery containers and are not designated for use as permanent storage tanks.

In practice, they do often serve a storage purpose in the short or medium term. Importantly, however briefly it is stored, an IBC containing chemical should never be left without a bund. Given that temporary IBC bunds are inexpensive and readily available, there is no excuse for taking such a risk.

Why bunding is vital

If a chemical container bursts very suddenly, it may have immediate effects on surrounding structures, environments and personnel. Often leakage events are more gradual, with impacts taking longer to appear. Either way, without a bund to contain it, the leaked chemical may cause devastation when it reaches a river, stream or other natural habitat.

Any company allowing such pollution will be held responsible for the resulting fish kill, environmental destruction and hazards to the human population. This is a PR disaster and may also be extremely expensive in terms of fines, enforcement undertakings, remedial works and other costs.

A search on the internet will soon show up recent prosecutions against businesses found responsible for unforeseen chemical leaks, with penalties amounting to hundreds of thousands of pounds. All these consequences can be avoided through well-designed, properly installed and carefully maintained bunding.

The 'rules' of chemical bunding

In the UK, a good place to start looking for detailed information on water industry standards relating to bunding is WIMES: Water Industry Mechanical and Electrical Specifications. WIMES, produced with the co-operation and approval of 17 water companies, define the requirements for a wide range of equipment used in this sector. WIMES 8.02 (Chemical Dosing Equipment – General Requirements) is particularly relevant and the advice in this white paper is consistent with its principles.

Bund material choice

Key factors determining the best material for a bund include the size of the storage containers, the nature of the chemical stored, and the bund's position and environment. The decision is also strongly affected by whether it will be built on-site or manufactured off-site – and indeed whether each of those options is feasible.

A bund's chemical resistance need not always be as high as that of a tank or other storage container, as it is not intended to hold chemicals continuously. The generally accepted rule of thumb is that a bund should be resistant for seven days to the chemical it is designed to contain.

The most traditional permanent bunds are built with concrete, brick or block walls, standing on concrete floors. These materials, and any mortar used in the masonry walls, must be watertight and capable of resisting the chemicals. Concrete, for example, may be attacked by strong acids.

In recent years, as off-site bund manufacture has grown in popularity, different materials and construction methods have become more common. One alternative for permanent bunds is prefabricated steel. However, this is susceptible to both atmospheric corrosion and attack by the stored chemical, so a special resistant coating must be applied to it.

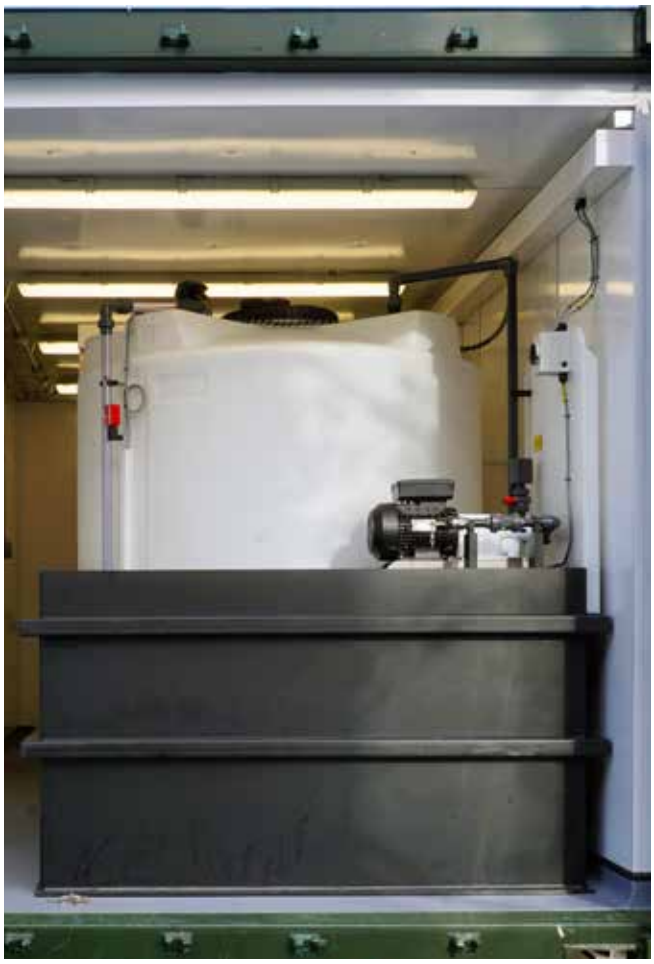
The water industry has seen some notable failures recently in steel bunds lined with GRP (glass-reinforced plastic), when used for ferric dosing storage tanks. Over time, the GRP lining can develop cracks or leak paths and allow contact between ferric chemicals and the steel. The bund's inevitable failure is accelerated if chemical spills are not removed.

By contrast, excellent chemical and atmospheric corrosion resistance is offered by permanent bunds manufactured off-site using plastics like polyethylene (PE), polypropylene (PP) and polyvinyl chloride (PVC). For these, ensuring the appropriate strength is important (see 'Bund design issues').

Temporary bunds for storage tanks up to 1,000 litres tend to be made from moulded low-density polyethylene (LDPE). This is a similar material to that used for some chemical IBCs, drums and other containers, so resistance is good, while moulding creates a robust structure. Steel is a further option for portable bunds, but again it is limited by the need for lining with a material resistant to chemicals and corrosion.

Bund design

Along with the growth in off-site and modular manufacture of chemical dosing systems, recent years have seen considerable evolution in bund construction methodology and design. For packaged systems up to around 30,000 litres, fabricated PE or PP bunds with a rectangular footprint are now commonplace. However, certain design issues must be addressed if they are to be considered viable alternatives to civil-engineered bunds constructed on-site.



The first thing to recognise is that plastic permanent bunds typically have a welded construction. Regardless of the welding quality, plastic welds are not usually as strong or chemically resistant as the base material. These bunds must be designed carefully and reinforced to ensure the appropriate strength. Like any bund, they need to be strong enough to contain the chemical, which is often considerably denser than water, and to withstand the shock load created by a full tank suddenly rupturing.

The design of a fabricated bund should always include reinforcement bands or added strengthening webs to reduce the load on welds. As well as protecting welds from high loads at the bund's corners, external bands stiffen the sidewalls. Without them, many rectangular fabricated bunds end up looking more like circular bunds when filled with water or chemical.

These bunds must also be capable of standing up to the rigours of handling. By its very nature, a bund manufactured off-site will be handled at every stage from completion in the workshop, through loading, transportation and offloading, to installation on-site. Although a bund may be designed to form a rigid unit when sitting on a flat base, all too often it proves to be very non-rigid when lifted or moved. Protecting a bund's integrity during handling may require purpose-made pallets, lifting points or additional fabricated features.

Temporary bunds, when moulded from a material like LDPE, have fewer problems as there are no welds or other stress points. However, those designed for transport by forklift may have special reinforcing features for extra strength and stability.

Bund size

WIMES 8.02 stipulates that bund capacity should be 110% of the total storage capacity of the largest tank or 25% of the total capacity of all tanks, whichever is the greater. If tanks are connected during operation, bund capacity should be 110% of their combined storage capacity.

However, requirements for outdoor bunds may differ a little between individual water companies. Thames Water, for example, insists on sizing at 110% plus 300mm wall height, while Yorkshire Water extends this to 130% in its own specifications.

Calculation of the necessary size for a bund must take into account any objects which take up volume within it and thereby reduce its effective capacity. These include supports, tank stands and various equipment.

The bund's wall height and floor area can be varied according to needs and circumstances. With a lower wall, and a correspondingly larger floor area, access for cleaning and maintenance is easier and tank condition can be viewed more clearly. There is also less potential load on the sidewalls.

If a chemical container bursts very suddenly, it may have immediate effects on surrounding structures, environments and personnel. Often leakage events are more gradual, with impacts taking longer to appear. Either way, without a bund to contain it, the leaked chemical may cause devastation when it reaches a river, stream or other natural habitat.

By the same token, low walls can be breached more easily by spigot flow – where a powerful jet of leaking liquid passes over the bund wall. This risk can be countered by installing splash screens. A low wall can also be breached by the tidal wave effect caused by sudden and catastrophic tank failure.

Higher walls, with correspondingly smaller floor area, have the advantage of a more compact, space-saving footprint. Their limiting factor is restriction of access for maintenance and space for valves and level sensors.

Bund protection from rain and other deposition

If a bund is to be located outdoors, exclusion or removal of rainwater must be considered. An outdoor, open bund will inevitably collect rain. It may be tempting to incorporate a drain for ease of emptying, but this is forbidden by the industry's standards. Instead, a submersible pump or eductor device should be provided. A sump makes emptying easier but is difficult to incorporate into a prefabricated bund. A more practicable approach may be to design a slight 'fall' into the plinth on which the bund is positioned.

Storage tanks with integrated thermoplastic bunds are sometimes fitted with permanent rain skirts. Otherwise, bunds can be protected from deposition by a shelter or cover. Some packaged chemical dosing plants are designed with fittings for this purpose. In addition to rain and snow, covers can be installed to keep out leaves and wind-blown debris. One chemical-specific issue is the need to avoid leaf drop into outdoor hydrogen peroxide bunds. Contact between leaked peroxide and organic materials can present a fire risk.

Bund monitoring and maintenance

At least once every 12 months, bund condition should be visually inspected – including close examination of internal surfaces and particularly any welds or crevices. If bund surface finishes or coatings are present, they should be inspected for signs of deterioration or delamination. External surfaces should be checked for any evidence of damage or chemical seepage.

Level monitoring systems are an essential element of bund equipment. They are fitted to generate an alarm if the chemical or rainwater in a bund exceeds a pre-set critical height. These should also be subject to at least annual inspection and testing. A bund's integrity should be tested every three to five years by filling it with water and checking for leakage or other issues over a specified length of time.

In the case of open bunds, planned preventative maintenance should include frequent removal of rainwater and environmental debris. Their accumulation reduces the

capacity remaining for leak containment. It should also be noted that if the leaking chemical has a lower specific gravity than water, a bund full of rainwater will disperse it straight over its wall.

Where rainwater is emptied daily, as part of a site's operating schedule, any liquid present in the bund on a dry day is useful in indicating small leaks. Where bunds are emptied less often, operators must ensure the water is not contaminated by chemicals before discharging it.

The risks highlighted in this white paper, along with mitigating preventative maintenance measures, should be included in the site's safety report. All operators working with bunds should be familiar with the applicable maintenance and operating procedures.

How to bund with confidence

The safest approach is to buy or hire complete chemical storage and dosing equipment set-ups from WES. They come with the most appropriate bunds, as well as all necessary filling and safety systems, and all components are pre-assembled and pre-tested. For easy installation and integration with the plant's existing operation, each delivery is also accompanied by the right pipework, connectors and control features.

An especially popular and convenient choice is the WES DS range of packaged chemical dosing systems. These highly portable packages can be used as standalone units or combined in larger, modular arrangements. Their bunds and integral tanks are usually made from HDPE (high-density polyethylene) – a material resistant to most chemicals.

They are typically constructed around an integral bund which acts as the base for a GRP cover, so there is no need to empty rainwater. The bund is fitted with external banding consisting of a steel box section encapsulated in plastic sleeves and welded to the sidewall. This enables a very compact design which nevertheless allows easy access for regular internal inspections.

WES also has a range of moulded bunds for IBCs available to hire. If a business already has satisfactory storage and dosing units in place but simply wishes to add appropriate secondary containment, WES can help. Drawing on its deep experience in this area, the WES team will provide expert advice and a specification that meets each situation's precise needs.

How WES can help

WES is an independent company dedicated to the design, engineering and supply of chemical dosing systems and services. Because we aren't linked to any single equipment manufacturer, we can provide our clients with unbiased advice about the technologies, approaches and solutions that best meet their needs. Our services can be as simple as the supply of an individual component, or as complex as the design, build and installation of large scale bulk chemical dosing systems. We pride ourselves in our ability to solve problems and keep our customers' process running, whether that involves the rapid delivery or temporary equipment on a hire basis or the development of innovative solutions to the toughest chemical dosing challenges.

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