13 Critical Factors Facing Chemical Storage

TECHNICAL WHITEPAPER

Polymaster

13 CRITICAL FACTORS FACING CHEMICAL STORAGE

Polyethylene (PE) has become the #1 material choice used to fabricate tanks storing chemicals and other corrosive and dangerous liquids.

Why?

Firstly, there is a huge cost benefit in using PE compared to other materials such as fibre-reinforced plastic (FRP) and Stainless Steel.

Secondly, PE has greater longevity and doesn't corrode when it encounters corrosive-type chemicals.

However, not all PE material is the same and not all tanks are engineered the same. This guide will provide you with a greater understanding of **Effective & Safe Chemical Storage!**

WHAT ARE THESE CRITICAL FACTORS?

Water storage solutions can sometimes be very simple, however storing chemicals can be challenging and technical. The key is to do your research, and work with companies who can modify and build a solution for your chemical storage or process applications.

Chemical storage solutions are usually all about compliance, standards, regulations and OHS issues due to the risk associated with storing volumes of chemical. A PE Chemical Tank is an important technical decision to make and therefore choosing the right company to work with is extremely critical.

Focus on making the right choice for your specified chemicals and ensure the supplier is;

a) certified to AS4766:2006 Polyethylene Storage Tanks for Water and Chemicals

b) understands the technical requirements for chemical storage

c) has the resources available and specialist engineers experienced in PE materials.

Carefully invest in a chemical storage option that is fit for purpose, has the right design life and efficient maintenance schedule taken into consideration.

1. CERTIFICATION/STANDARD - AS/NZS 4766

The Australian Standard for PE tanks for storing chemicals is AS/NZS 4766 Polyethylene Storage Tanks for Water and Chemicals.

This standard provides a benchmark of quality and ensures that the tank is submitted to testing post manufacture and audited by an independent 3rd part auditor. Each company that is certified to this standard will have a list of products that are on their certification register, so double check to ensure that the tank you are intending to use is registered.

The post-manufacture tests on a PE chemical required by AS/NZS 4766 include:

- Thickness Testing – Once the tank is moulded it needs to be tested in at least 20 places around the tank; the roof, walls and base are tested with an ultrasonic thickness tester, to ensure that the minimum wall thickness has been achieved. If one of the tests returns a negative result, the tank cannot be used.

- Impact Testing – After the tank is moulded, a sample piece is cut from the manhole area of the tank and is frozen to -40°C (that's as cold as the Arctic gets!). This sample is placed inside a machine where a heavy 13.5kg dart is dropped from a height of 1.5 metres onto the sample (= to 4 tonne) – if the sample shatters or cracks it is a fail and cannot be used.

- Serial Number – all details are recorded against a serial number for tracking

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In addition to the above, the design of every tank model needs to be FEA (Finite Element Analysis) engineered. An FEA is a computer simulated assessment which determines the potential 'stress' points around the tank and specifies the required wall thicknesses.

As a requirement for certified tanks they MUST be designed without the need for center support pole – ensuring the roof is self-supporting.

2. CERTIFIED MANUFACTURER

Ensure that the tank you select is made by a certified manufacturer that is an expert in chemical storage. PE tanks used for storing water are not necessarily suitable for storing chemicals!

Manufacturers experienced in chemical storage should have resources available and specialist engineers experienced in PE materials. Ensure you speak to them to discuss your application.

Standard documentation and procedures by manufacturers should include:

- Inspection Test Plan (ITP) completed for every tank
- Markings on the tanks stating certification to AS/NZS 4766
- Documentation of testing completed according to AS/NZS 4766
- Hydrostatic Testing
- Construction Drawings

3. ULTRAVIOLET AND ANTIOXIDANT PROPERTIES

Australia has one of the highest levels of UV exposure. Long term UV degradation can have more impact on the integrity of a PE chemical tank than chemical degradation. For a design life of 25 years, the minimum UV resistance requirement must not be less than UV25.

The aggressive chemical attack on PE of some corrosive chemicals can affect the long-term performance of a tank. This is a result of the oxidative effects of chemicals like Sodium Hypochlorite and Sulphuric Acid.

It is critical that the ESCR (Environmental Stress Crack Resistance) and antioxidant levels of a chemical tank is suited for storing aggressive chemicals long term. Technical advice on the suitability of certain chemicals to be stored inside a PE tank should be analysed by a Chemical Engineer trained as a Polymer specialist.

4. TANK SIZE & VOLUME

Many applications have tanks that are too small in capacity. Ensure that when you size up the tank you consider the following:

1. Select the tank by its effective capacity – don't confuse this with the nominal capacity.

2. Refill quantities - Check the delivery volume options of your chemical supplier. Allow for an additional 20% above the refill delivery quantity so that you can allow for potential delays in delivery.

3. Outflow rates – Ensure you have sufficient capacity to allow for the delay between ordering a new a chemical delivery and it's arrival.

Some chemicals have a shelf life and will deteriorate over time so it's not always a good idea to be storing a lot more chemical than you need. It's recommended that the chemical provider is consulted to confirm the characteristics and shelf-life of each chemical.

5. CHEMICAL DELIVERY

Most chemical suppliers will have a set of guidelines that include the requirements that need to be met before they will fill a tank. This will include; truck access, proximity of safety showers, specific fittings/couplings and design elements to ensure easy fill and OH&S risk mitigation.

Filling through the top of a tank is always best practice, however for taller tanks, a Top Fill Assembly can be utilized to make this easier and do away with the need to reach the top of the tank with platforms.

Bulk Deliveries - The filling connection on the tank needs to be the correct pipe size and connection - generally a camlock which needs an isolation valve.

- It's also recommended that there is a drain valve which will allow the remaining chemical in the line to be drained.
- The camlock connection is required to be between 600-900mm above the ground.
- A warning system for high level alarm is requirement so that the operator filling the tank knows when the level is reaching a point close to overflowing. It's also a good idea to have an automatic shut-off to the filling line when the tank reaches its maximum volume.

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IBC Deliveries – When chemicals are being delivered via IBC, there is the option of either pumping the chemical from the IBC into the tank or gravity feeding from an IBC into a tank, this is called an IBC Mother Tank. If pumping from an IBC, then all the points in the 'Bulk Deliveries' section above, need to be considered.

Filled from Process – If the chemical tank is being filled from a process or constant supply, then high level alarms are paramount. Typically, all constant feed lines have the potential to overfill the tank and therefore a high-level alarm with second redundancy and automatic cut-off to the feed process is essential.

6. MATERIAL OF CONSTRUCTION

There are over 1,956 chemicals that can be stored inside polyethylene tanks, however each chemical has different characteristics depending on its chemical composition. Therefore, each chemical needs to be double-checked for its suitability with PE - no assumptions should be made!

Different types of PE material is available for different applications, these include:

- 7065 HDPE material (used for high-oxidising chemicals such as Sulphuric Acid, Sodium Hypochlorite, Hydrogen Peroxide)
- 7060 HDPE material (most common type, used for many chemicals, has a good level of anti-oxidants)

Along with the tank material construction, it's important to consider other materials for the fittings, pipework and equipment that is attached to the tank and their compatibility with the chemical being stored.

The best way to ensure the correct material is specified for your application is to send the SDS (Safety Data Sheet) to the tank manufacturer.

7. CHEMICAL COMPATIBILITY AND CHARACTERISITCS

Different chemicals have different reactions and characteristics. It's important to be aware of how chemicals act when they are stored in volume. Some chemicals have a set shelf life, and some will degrade in strength over time. Apart from the composition of the chemical, the following factors also need to be considered as they may affect the design of the storage tank:

- Strength (%) of the chemical
- Temperature of the chemical
- Volume of the chemical being stored

These factors should be considered and careful analyzed by a PE specialist engineer to recommend the most suitable tank design for each application.

Some chemicals will also have corrosive fumes, if not treated properly these will cause serious corrosion and degradation issues with equipment on and around the tank. There are several ways to treat fuming chemicals, including wet scrubbers and desiccant air dryers. Different methods are suitable for different applications, so check with the engineering team at Polymaster to be advised on the best solution for your application.

8. GENERAL LOCATION

When determining the location and position for the installation of the tank, there are a few factors to consider:

- According to Australian Standards, there are minimum separation distances that need to be maintained between certain types of chemicals. This means that a set minimum distance must be between the tanks and bunds storing these chemicals.
- Another factor to consider is any source of heat or flame around the area. This needs to be especially considered when a PE chemical tank is being connected near a piece of equipment that may have an exhaust or produce heat whilst it's running. The need to identify this is due to the potential for the chemical to heat up which could have an adverse reaction with the heat of cause it to fume.
- Most chemical tanks when full will be heavy enough to prevent them from moving in general weather conditions. However, consideration needs to be made for the tank if it was ever empty and adverse weather conditions arose. It is therefore highly recommended to put bolt down lugs onto a PE chemical tank to prevent them from shifting.

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9. SECONDARY CONTAINMENT

Industry and Australian Standards request secondary containment for most dangerous chemicals. Secondary containment is designed to hold the entire contents of the tank if the chemical should exit the storage tank unwantedly. This could be for many reasons including; tank failure causing it to leak, overfilling the tank or valve failure.

When designing the secondary containment (bund), the following factors need to be considered:

a) Secondary containment bund needs to hold minimum 110% volume of the storage tank
in most applications.

b) Secondary containment needs to be built or coated with materials that are impervious
to the chemical being stored.

c) Allow for spray angle from top of tank of 26.5° to be within the bund – good practice.

d) Build a roof over the secondary containment area to avoid catching rainwater.

An ideal solution to these concerns is a self-bunded tank. A self-bunded tank is weather-proof, greatly reduces the footprint on-site compared to a traditional style open-top secondary containment bund and there is no requirement to construct a roof over it.

10. FLEXIBLE PIPE CONNECTIONS

It is critical that connections to the welded fittings on a PE tank are of flexible nature to allow for expansion and contraction of the tank. PE tanks will flex slightly depending on varying temperature conditions and how full the tank is. PE tanks are engineered this way.

If rigid pipe is being connected directly to the fitting on a PE tank, you will need to install a rubber expansion coupling between the fitting and the rigid pipework. Alternatively, you can install flexible piping to the outlet.

Consult the Installation and Operation Manual of the manufacturer for more details.

11. SPECIFIC GRAVITY RATINGS

All liquids have a certain weight to volume ratio which is generally called Specific Gravity (SG) or Bulk Density. Water has an SG of 1, meaning that 1,000 litres of water weighs 1,000kg. Most chemicals have a SG that is great than 1 and therefore it's critical to ensure that the PE tank you install is suitably rated to withstand the weight of the liquid being stored. Generally, a safety margin is applied to the tank's rating so that there is no chance of tank failure.

Much of a PE tank's strength comes from the thickness of its shell structure: the thicker the shell, the stronger the tank - meaning it can store heavier chemicals.

Other factors to consider;

a) design of the tank

b) the PE material being used

c) its long-term creep rating, and

d) temperature of the liquid being stored.

It's recommended for a PE specialist engineer to analyse your application and put forward a recommendation.

12. STANDARD CONNECTIONS

According to Australian Standards and general industry practices, the following list of fittings is a minimum for any chemical tank:

- Fill connection
- Outlet
- Overflow - Min. 1.5 x diameter of inlet
- Level indication - Mechanical and electronic is recommended
- Vent – Min. same size as inlet/outlet (whichever is larger)
- Inspection lid – if personnel access required 600mm
- Drain fitting
- Bolt Down Lugs

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Careful consideration should be given to ensure that there are enough fittings on the tank to allow for effective operation. The size and type of the fittings should also be double checked to ensure they suit requirements. It's also a good idea to undertake a Risk Assessment for any PE chemical tank installation to ensure that all potential risks and hazards have been considered.

13. TANK FOUNDATION (BASE)

The foundation that any tank sits on is critical to ensure that it is supported adequately without the risk of causing fatigue to the tank and potential failure.

A PE tank should be mounted on a base that is hard and flat without any sharp objects where the tank will be placed. The slab needs to be engineered to support the weight of the tank without flexing or breaking.

It's also recommended that the foundation of any tank extends at least 300mm past the edge of the tank. If the foundation is not concrete, its ideal to have a roof structure over the tank or drainage to deal with the rainwater run-off to avoid erosion.

Consult the Installation and Operation Manual of the manufacturer for more details.

BONUS : Included is the "Chemical Tank Installation Checklist"

There are many points that need to be considered and to be aware of when installing a PE Chemical Tank, but this document provides a guide for the most important things to consider. Diligence is required right from the planning stage through to design and installation. A maintenance plan should also be put in place to ensure the integrity of your chemical tank is maintained.

An onsite Tank Inspection is also a good idea for any existing tanks that are in service storing chemicals. Sometimes the critical information mentioned in this document is not available for existing tanks, so Polymaster is able to come to site to examine any PE tanks and prepare a Tank Inspection Report.

Do you have specific questions on chemical storage? Let us know! Contact a chemical storage expert from our Industrial Division who can guide you through developing a storage solution that meets your needs. Polymaster has the expertise and resource to assist you in design, consulting, manufacture, onsite support, project management, installation, and removal of old chemical tanks.

CHEMICAL TANK INSTALLATION CHECKLIST

1. Proposed Tank Certified to AS/NZS 4766
2. Discussed application with manufacturer's Technical Engineer
3. Tank has 25-year Design Life in Australian conditions
4. Tank Capacity allows for refill quantities available
5. Fill line on tank is suited to chemical delivery company requirements
6. Chemical SDS has been sent to tank manufacturer for analysis
7. Characteristics of chemical have been catered for in tank design – fume scrubbers etc.
8. General location of tank has been carefully analysed for potential risks
9. Secondary containment is suitable for proposed tank volume and chemical considered Self Bunded Tank to save space
10. Flexible connections have been sourced for each fitting
11. Tank SG rating is above chemical SG
12. All standard connections are in the tank design:
    a. Fill
    b. Outlet
    c. Overflow
    d. Level Indicator
    e. Vent
    f. Inspection Lid
    g. Drain Application
    h. Bolt Down Lugs
13. Tank Foundation is suitable for tank loading and weather erosion

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