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ACAPMA

Best Practice Guidelines

Biofuels Storage & Management

2017 Version

ACAPMA
The Voice of Downstream Petroleum

ACAPMA
Australasian Convenience and Petroleum Marketers Association

ABOUT THIS DOCUMENT

This document is one in a series of *Best Practice Guidelines* that has been prepared by the Australasian Convenience and Petroleum Marketers Association (ACAPMA) to assist fuel retailers with the management of their retail fuel sites.

The material provided in this document is of a general nature only. It is not intended for use by suppliers of equipment and services to the fuel retail industry in Australia given that much of this information is already detailed in relevant Australian Industry Standards and related Legislative Guidelines.

Rather, the information contained in this document is intended to provide a *Plain English* summary of the best practice processes that fuel operators should consider with respect to the ongoing management of key aspects of their retail fuel sites.

Fuel retailers seeking detailed information in relation to the design and/or alteration of service station infrastructure are strongly advised to secure the services of a qualified fuel system designer and/or petroleum services contractor.

The contact details of such contractors can be obtained by visiting **www.acapma.com.au** or calling the ACAPMA Secretariat on 1300 160 270.

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1. SCOPE OF CONSIDERATION

This Guideline has been developed to provide guidance with respect to the storage and management of biofuels in Australia. The scope of this Guideline extends to:

- Conversion of existing underground tanks from storage of conventional fuels to storage of low-blend biofuels (E10 and/or B5)
- Compatibility of storage and fuel system architecture with E10 and B5 operation
- Maintenance and monitoring of biofuels storage and fuel system operation
- Key human health and safety considerations relating to the storage of biofuels
- Key environmental considerations associated with the storage of biofuels.

Importantly, this Guideline is not intended to provide detailed guidance with respect to the design and installation of new underground storage systems for biofuels.

Information in this regard should be sourced from the relevant Australian Standards, as interpreted by a suitably qualified petroleum systems designers and/or petroleum services contractor.

2. BIOFUELS OVERVIEW

Biofuels are alcohols or esters that are produced from organic material, typically plant materials (i.e. corn, sugar and wheat starch) or animal by-products.

They are typically blended with conventional fuels to produce transport fuels that can be readily substituted for traditional transport fuels in many modern vehicle engines.

Biofuels are sold in Australia as either petrol-ethanol blends (for use in petrol-powered vehicles) or biodiesel-diesel blends (for use in diesel-powered vehicles).

2.1 PETROL-ETHANOL BLENDS

Ethanol produced in Australia is typically distilled from agricultural products and waste products such as wheat starch, sugarcane and red sorghum.

The ethyl alcohol that is derived from this process is typically blended with petrol at the ratio of 10% ethanol with 90% petrol to produce a product typically referred to as 'E10'.

Like petrol and diesel, the quality of ethanol sold for use as a transport fuel in Australia is regulated under the Australian Fuel Quality Standards Act (2000).

A related regulation, the Australian Fuel Information Standard (Ethanol) Determination 2003, requires that all E10 sold into the Australian market must be clearly labelled to inform consumers that they are purchasing ethanol. (Failure to adequately label E10 at service stations is an offence under Section 12A of the Australian Fuel Quality Standards Act 2000.)

Higher petrol-ethanol blends are available at a small number of outlets in Australia (i.e. E85) but this fuel is only suited to vehicles that have been specifically modified to accommodate these blends.

Importantly, ethanol is a bipolar solvent (i.e. water attractor). In the presence of water, the ethanol can react to form a corrosive film that can be damaging to fuel storage and fuel dispensing infrastructure.

Australian experience of the effects of E10 on fuel storage and dispensing infrastructure is relatively limited given that biofuels have, until recently, largely been available in just one Australian state (i.e. NSW since 2008).

International experience with E10 blends is much more extensive than within Australia with some countries having accumulated over 20 years of market experience.

In the USA, for example, E10 usage became significant in the mid-1990s. Today, most of the petrol sold in the country is an E10 blend.

The American Petroleum Institute (API) first produced guidelines for checking the compatibility of tank and line materials with ethanol blends in 1985. These guidelines have been periodically revised to take account of industry experience.

While many manufacturers stipulate that their current products are suitable for E10 fuel, fuel retailers should exercise extreme caution when switching existing tank and fuel system infrastructure from conventional petrol operation to E10 blend operation – particularly where the age and material composition of the in-ground storage is unknown.

2. OVERVIEW

2.2 BIODIESEL-DIESEL BLENDS

Biodiesel is typically manufactured by reacting oils derived from plants (e.g. vegetable oil, soy bean oil, palm oil) or animals (e.g. tallow) with an alcohol. Depending on the nature of the oil or fat used, some biodiesels are prone to coagulating at low temperatures which requires that the fuel be heated during winter months to maintain its liquid state.

Like conventional fuels, the quality of biodiesel is regulated under the Fuel Quality Standards Act (2000) with manufacturers and suppliers required to produce a fuel that meets key quality parameters.

In Australia, biodiesel is typically sold as a blend, with biodiesel at either 5% and 95% diesel (i.e. B5) or 20% biodiesel and 80% diesel (B20).

Under the Fuel Standard (Biodiesel) Determination 2003, B5 can be sold as 'diesel' while B20 must be clearly labelled given that the higher biodiesel concentration generally requires that the vehicle engine be slightly modified to accommodate this blend.

It has been generally thought that B5 can be readily substituted for conventional diesel without the need for modification of tank infrastructure or dispensing infrastructure, largely due to biodiesel being a relatively benign compound.

There is, however, research coming out of the USA suggesting that there is a need to monitor tanks that are used to store biodiesel blends – including low volume blends such as B5.

In a report released in June 2016, the USEPA found moderate or severe corrosion in 83% of the underground biodiesel tanks that were studied. A significant proportion of these tanks were new tanks and the corrosion was observed in both steel and fibreglass tanks.

While the exact cause of the tank deterioration was not isolated by the study (i.e. the scope of the study was to examine tank condition rather than identify the cause of any problems), it was thought that the recent lowering of the sulphur content of diesel was contributing to an increased rate of microbiological corrosion caused by the organic elements reacting with water in the tanks.

3. TRANSITIONING UNDERGROUND TANKS TO BIOFUELS OPERATION

Past industry experience with biofuels mandates in NSW, coupled with an analysis of available international research on low volume biofuels blends in Europe and North America, reveals that there is a need to exercise caution when transitioning existing underground storage tanks and dispensing infrastructure to biofuels operation.

This experience reveals that potential issues can arise due to the incompatibility of some materials for biofuels use or where the age and condition of existing infrastructure is not sufficient to support biofuels operation.

Fuel retailers seeking to transition their existing infrastructure to biofuels operation in Australia are strongly advised to follow the seven-step process outlined in Table 1.

STEP	ACTION	CONSIDERATION
1	Determine the nature of the materials used in the construction of your underground tanks (i.e. steel, single-walled fibreglass, double-walled fibreglass).	Some tank materials appear prone to deterioration over time when exposed to low-blend biofuels. This information can be used to better understand the risks of storing biofuels in tanks that are made of materials that have been prone to such deterioration.
2	Determine the age and manufacturer of your underground tanks from site records.	Age can be an indicator of the condition of your tank, with older tanks likely to be more prone to damage arising from a transition to biofuel operation. Consult with the manufacturer for advice on the compatibility of your tanks with biofuels. Where the age and manufacturer of existing underground tanks cannot be determined, there is currently no economic way to determine (with absolute accuracy) whether they are compatible with biofuels operation.
3	Obtain a report from a qualified contractor about the condition of your underground tanks and fuel system.	In cases where the tanks are made of materials that are prone to damage by biofuels, it is recommended that aged (e.g. more than 15 years) or unknown tanks and fuel system infrastructure are inspected to ensure that they are still in a serviceable condition. This report should be kept for future reference as it provides a form of insurance against prosecution if the tanks are later found to be unsuitable for biofuels operation.
4	Review your UPSS reporting records (i.e. SIRA reporting system) to determine whether there have been any recent discrepancies in volumes that could be an indication of tank leaks.	Discrepancies in tank volume monitoring systems are generally an early indicator of failing tank condition that will likely be made worse by the introduction of biofuels. If you do not currently utilise a monitoring system for tank volumes, it is strongly advised that such a system be installed immediately (in accordance with AS4897).
5	If the tanks were manufactured from materials that are suspected of not being compatible with biofuels, then the tanks should be replaced before moving to biofuels operation (refer to Section 4 of this Guideline).	Such an exercise can be costly to the fuel retailer and/or may require the fuel retailer to make changes to infrastructure that they do not own (i.e. site operator leasing a retail fuel site). Where the fuel retailer is required to make the changes as part of complying with a biofuels mandate and believes that such changes cannot be reasonably funded, an application for exemption should be made to the regulatory authorities.
6	If the tanks are generally in good condition and an analysis of UPSS monitoring records shows no issues, then the tanks should be drained of existed product, cleaned and flushed before being filled with biofuels.	It is essential that the tanks be cleaned and all sludge removed from the bottom of the tanks as high volumes of sludge (and water) create the preconditions for either the formation of a corrosive layer of water/ethanol paste (in the case of E10) or to the formation of microbiological corrosion (in the case of B5). Both conditions will threaten the integrity of the tanks over a relatively short timeframe.
7	Install enhanced UPSS monitoring/leak detection systems.	Fuel retailers are strongly encouraged to utilise enhanced UPSS monitoring systems and implement regular (i.e. annual) inspection of underground tanks used for the storage of biofuels.

Table 1: Recommended process for transitioning existing underground fuel tanks to biofuels operation

4. MATERIALS COMPATIBILITY

4.1 PETROL-ETHANOL BLENDS (E.G. E10)

It is important that material compatibility with ethanol blends is checked before switching existing fuel system infrastructure to biofuels operation.

Many infrastructure manufacturers have Underwriters Laboratories (UL) Certification or provide statements of compatibility of their products with ethanol blends.

There are also a variety of USA industry resources that provide easy access such as the Petroleum Equipment Institute's UST Component Compatibility Library website (**see: www.pei.org/ust-component-compatibility-library**) and the US Department of Energy Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends (**see: www.nrel.gov/docs/fy16osti/65744.pdf**).

4.1.1 Isophthalic resins (tanks)

Non-compatible resins (e.g. isophthalic and/or orthophthalic resins) were previously used in the fuel industry for single-walled fibreglass tanks.

Consequently, many of the single-walled fibreglass tanks installed prior to 1997 may have utilised these resins. Some single-walled fibreglass tanks manufactured after 1997 may also have been constructed with a non-compatible resin. (Owners of these tanks should check with their manufacturer.)

These resins are softened by the ethanol that exists in E10 that can lead to structural failure of the tank.

Retailers who have single-walled fibreglass tanks (especially those manufactured prior to 1997) are strongly advised to contact their tank manufacturer to determine whether the resin used in the manufacture of their tanks is compatible with E10 storage.

Any tanks using these non-compatible resins must not be used for E10 storage.

4.1.2 Steel tanks

Steel is generally accepted as being compatible with the storage of biofuels, including ethanol blends.

It is worth noting, however, that some retailers have reported issues with steel tanks following a transition to E10 operation.

It is unclear, however, whether the problems experienced by this latter group of retailers were due to the incompatibility of the nature of the steel used (i.e. which varied over time) or occurred because of the poor condition of the steel tanks prior to E10 operation.

If the steel tank has been relined with another material, the fuel retailer should seek expert advice on the compatibility of the lining material with E10 operation.

E10 will typically 'scrub' the walls of steel tanks by removing rust and gum deposits that have built up on the walls of steel tanks over time. If the level of pre-existing rust and/or gum is substantial, it is possible that this removal can expose a leak problem.

It is recommended that, unless the tank has been newly installed, a comprehensive UPSS monitoring system be introduced (including monitoring wells) if E10 is to be used in an older steel tank.

4. MATERIALS COMPATIBILITY

4.1.3 Double-walled fibreglass tanks

Typically, these tanks are a more recent innovation and there are no substantive reports of problems encountered with the storage of E10 in these tanks.

Nonetheless, it is recommended that the performance of these tanks be monitored in accordance with the practices outlined in Section 5 of this paper.

4.2 BIODIESEL BLENDS (E.G. B5)

Based on past industry experience, most common forms of tank construction have operated satisfactorily with low biodiesel blends (i.e. B5).

There are, however, suggestions of an emerging issue associated with the degradation of all forms of underground storage tanks (i.e. fibreglass and steel construction) caused by microbiological corrosion. This problem has become particularly apparent since low sulphur diesel was introduced into the market.

Satisfactory management of this issue appears to have more to do with fuel management and tank maintenance processes (refer to Section 5 of this Guideline) than with the materials used in the construction of the tank.

5. MAINTENANCE AND MONITORING PRACTICES

5.1 PUMP AND DISPENSER SEALS

E10 is not compatible with nitrile-based seals (or cork-based or cardboard gaskets) and consequently pumps fitted with these seals and gaskets should be replaced with seals that are compatible materials (seek advice from the manufacturer).

Care should be taken with pumps and nozzles that utilise brass- and zinc-plated components as the working life of these materials is typically shortened for E10 operation.

It is recommended that fuel retailers contact their pump and dispenser provider to discuss the suitability of existing dispensing equipment for biofuels operation – and agree to a maintenance strategy for this equipment in the future.

5.2 PUMP FILTERS

Biofuels tend to produce small amounts of algal material in the tank that are screened out by pump filters.

Any move to biofuels operation (e.g. E10 and B5) will therefore require the fuel retailer to increase the frequency of filter change intervals – particularly in the period immediately following the changeover to biofuels operation.

5.3 UPSS MONITORING

The monitoring of the performance of UPSS is recommended for all underground fuel storage tanks, regardless of product. In fact, AS4897 specifies such monitoring as standard practice for the fuel industry in Australia and New Zealand.

Where biofuels are being used in older tanks, or tanks where there is a question mark over the durability of the tank materials (refer to Section 4), it is strongly recommended that an enhanced UPSS monitoring system or leak detection system is implemented to maximise the potential for early identification of tank breaches.

5.4 PRESSURE MANAGEMENT

E10 typically has a vapour pressure that is around 10% (or 6kPa) higher than that of conventional petrol. Consequently, it is essential that the venting system is reviewed to ensure compatibility with E10 operation.

Such a review is essential in cases where vapour recovery infrastructure is installed with pressure vacuum vents.

5.5 FUEL MANAGEMENT

Ethanol has a strong affinity to water. The presence of a significant amount of water in the bottom of an E10 tank can result in phase separation, where the ethanol is attracted out of the E10 volume to mix with water.

The impact of phase separation is typically: (a) to reduce the octane rating of the fuel product being sold to customers, and (b) to foster microbiological growth than can accelerate tank corrosion.

To avoid these impacts, the fuel volume should be regularly tested for the presence of water.

Where phase separation occurs, a qualified contractor should be engaged to remove the water/ethanol layer which can often be both flammable and toxic.

In relation to biodiesel/diesel blends, care should also be taken to remove excess water to prevent accelerated corrosion due to microbiological corrosion and maintain the fuel in fit-for-purpose condition.

6. LEGAL OBLIGATIONS

6.1. BIOFUELS MANDATES

Compulsory biofuels mandates have been introduced in some Australian states and territories, most notably New South Wales (2007) and Queensland (2017).

These mandates require eligible fuel retailers to stock and sell E10 and B5 with provision for substantial fines for non-compliant retailers.

It is important to note, however, that these laws also make provision for fuel retailers to be exempted from the biofuels mandates for a variety of valid reasons.

These reasons include where the fuel retailer's storage infrastructure is not suitable for biofuels operation and the cost of replacing this infrastructure cannot reasonably be shouldered by the business.

6.2 RELATIONSHIP WITH OTHER LEGAL OBLIGATIONS

It should be noted that any requirement to comply with a biofuels mandate does not excuse the fuel retailer from compliance with all other relevant safety, environmental and fuel quality regulations.

Where compliance with a biofuels mandate is likely to conflict with such regulations, the fuel retailer should immediately seek to discuss these issues with the regulator and/or seek exemption from the biofuels mandate.

Fuel retailers should ensure that due account is taken of the potential for degradation of the quality of the feedstock fuel (e.g. biodiesel) over time, to ensure that the blended biofuel being sold at their facility is fit for purpose.

7. HUMAN HEALTH AND SAFETY CONSIDERATIONS

7.1 SAFETY DATA SHEETS

Safety Data Sheets (SDS) for biofuels (E10 and B5) should be produced and made available to personnel working at all sites selling or storing biofuels – as with other petroleum fuels.

These SDSs should not only be prepared for E10 and B5 but should also be prepared for ethanol/water mixes that can occur in tanks as such solutions are toxic and can be flammable.

7.2 OH&S CONSIDERATIONS

Ethanol is toxic to humans in its pure form. Exposure to small doses will tend to place the person in a relaxed and euphoric mood; people experiencing these symptoms tend to become talkative and less inhibited, and may exhibit poor judgment.

At higher levels of exposure, ethanol acts as a central nervous system depressant, producing at progressively higher dosages, impaired sensory and motor function, slowed cognition, stupefaction and unconsciousness.

The OH&S aspects for B5 are wholly consistent with conventional diesel.

It therefore follows that exposure to biofuels (like all fuels) should be minimised as far as possible in strict accordance with prevailing state/territory OH&S legislation.

7.3 FIRE SAFETY CONSIDERATIONS

Ethanol blended petrol (E10) has a slightly higher flash point than conventional petrol and can result in a slight increase in the upper flammability limits.

The fire-fighting procedures used for fires involving E10 should be the same as for conventional petrol and include use of either of the following agents:

- Dry chemical, at the same application rate as for petrol (unless otherwise specified by the manufacturer)
- Alcohol-resistant foam at the same rate of application as for petrol fires (unless otherwise specified by the manufacturer).

8. KEY ENVIRONMENTAL CONSIDERATIONS

Ethanol and biodiesel are organic solutions that typically break down (i.e. biodegrade) in both water and soil which means that the long-term effects of their leakage into either are minimal.

Given that ethanol and biodiesel are blended with petrol and diesel – fuels that are generally not biodegradable – the same precautions should be taken for blended biofuels (i.e. E10 and B5) to prevent discharge into water and soil as for conventional petrol and diesel.

SUMMARY

The physical and chemical properties of ethanol-blended petrol (i.e. E10) and biodiesel-diesel blends (i.e. B5) require that fuel retailers take all reasonable precautions to ensure that their existing fuel infrastructure is compatible with the storage and dispensing of these fuels over time.

Failure to ensure compatibility can result in costly damage to fuel system infrastructure and/or leakage of fuel into the neighbouring environment – with significant risk of prosecution and fines.

In all cases, fuel retailers should seek advice from a qualified petroleum services contractor (or consultant) before moving to a retail operation that incorporates biofuels (i.e. E10 and B5).

Where the cost of any necessary changes to fuel infrastructure at a site cannot reasonably be borne by the fuel retailer, current biofuels legislation in NSW and Queensland makes provision for the fuel retailer to be exempted from the biofuels mandate.

Fuel retailers should not, under any circumstances, proceed with the changeover to biofuels operation of existing infrastructure where the compatibility of this infrastructure with biofuels operation cannot be determined.

Further information about this Guideline can be obtained by contacting ACAPMA on 1300 160 270 or emailing the ACAPMA Secretariat at **communications@acapma.com.au**.

GLOSSARY OF TERMS

B5	A blended fuel containing up to 5% biodiesel with conventional diesel on a volume basis
BIODIESEL	Biodiesel is a diesel fuel produced from vegetable oils or animal fats and typically sold as a blend with mineral diesel
BIOFUELS	Fuels that are produced from biomass using biological processes. They include ethanol and biodiesel.
BIOFUEL BLENDS	Typically refers to transport fuels that comprise a blend of conventional petrol with ethanol (ethanol-petrol blend) or diesel and biodiesel (biodiesel blend)
ETHANOL	A colourless, flammable liquid that is produced by the natural fermentation of sugars or via petrochemical processes using biomass
E10	A blended fuel containing up to 10% ethanol with conventional petrol
ISOPHTHALIC RESIN	A high-strength polyester resin that was traditionally used in single-walled fibreglass underground fuel tanks sold in Australia up until the late 1990s
LOW-BLEND BIOFUELS	These are fuels where the proportion of biofuel blended with conventional fuels (i.e. petrol and diesel) is relatively low. Examples include E10, B5, B10 and B20
ORTHOPHTHALIC RESIN	A moderate-strength polyester resin that was used in the manufacture of some of the older single-walled fibreglass underground fuel tanks sold in Australia
OH&S	Occupational Health and Safety
SDS	Safety Data Sheets

USEFUL REFERENCES

American Petroleum Institute (2010)	Storing and handling ethanol and gasoline-ethanol blends at distribution terminals and filling stations **www.global.ihs.com/doc_detail.cfm?document_name=API%20RP%201626&item_s_key=00137888&rid=TIA#abstract-section**
National Renewable Energy Laboratory (2015)	E15 and Infrastructure **www.nrel.gov/docs/fy15osti/64156.pdf**
Petroleum Equipment Institute (2017)	UST Component Compatibility Library **www.pei.org/ust-component-compatibility-library**
Tank Solutions (2017)	Glasteel II Underground Fuel Warranty **www.tanksolutions.com.au/wp-content/uploads/2016/03/F-1030-Warranty-GS.pdf**
US Department of Energy (2017)	Handbook for handling, storing and dispensing E85 and other Ethanol-Gasoline blends **www.nrel.gov/docs/fy16osti/65744.pdf**
US EPA (2016)	Investigation of corrosion-influencing factors in underground storage tanks with diesel service www.epa.**gov**/sites/production/files/2016-07/documents/diesel-corrosion-report_0.pdf
US Steel Tank Institute (2012)	Steel Facts Bulletin (No. 2) **www.steeltank.com/Portals/0/media/Steel%20Facts%20No.%202-Biofuels%20Compatible%20v%2010.5.11.pdf**

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