

Guidance note for filling station operators on the storage and handling of biofuels at filling stations

Introduction

This guidance note is to be used in combination with the *Guidance for the storage and handling of biofuels at filling stations*, which is available from the Energy Institute (EI) (<http://publishing.energyinst.org>). The European Directive 2009/28/EC promotes the use of biofuels or other renewable fuels to replace part of the diesel and petrol sold in Member States. The UK Government's response is the Renewable Transport Fuel Obligation. This places an obligation on road fuel suppliers to ensure that a target percentage of their total road fuel sales are biofuels.

The term biofuel used in this guidance refers to petrol blended with ethanol and diesel blended with fatty acid methyl ester (FAME). Biofuels continues to come under EN 228 *Automotive fuels – Unleaded petrol – Requirements and test methods* and EN 590 *Automotive fuels – Diesel – Requirements and test methods* which permits composition of petrol and diesel fuels respectively allowing up to 10% ethanol in petrol and 7% FAME in diesel.

Key features

Although E5, E10 and B7 are within the scope of EN 228 and EN 590 respectively, there are certain features of these fuels that differ from those that do not contain the biocomponent. These are described below.

Phase separation

Unlike petrol, ethanol is highly soluble in water. When the water content of the E5 or E10 blend reaches a critical level the ethanol component and associated water will separate from the petrol to produce a separate ethanol/water phase. This will accumulate at the bottom of a tank leaving petrol (without the ethanol component) in the upper layer; this is known as phase separation. If phase separation occurs the process is essentially irreversible, there is no straightforward means of re-blending the ethanol back into the petrol at a filling station. In most cases, both phases will need to be taken off site for specialist treatment.

Microbial growth

Bacteria, yeasts and moulds can enter a filling station storage system through the distribution chain via tanks, pipelines, filters, water and air. It is in the water phase that microbes survive, drawing nutrients from the fuel phase. With the addition of the FAME component in B7 blends, the nutrient sources available for microbes will be higher than in standard diesel. Microbial growth in the water phase can exacerbate localised corrosion, which may result in the blocking of dispenser filters and fuel lines. Where microbial contamination has developed, especially where biofilms have attached, physical cleaning and decontamination of the system is usually required.

Solvent properties

The solvent properties of E5, E10 and B7 can have a cleaning effect on existing storage systems. This can cause a softening and loosening of any organic residues, dirt or scale present in the tank system. This loosening can bring the material into a suspended state, and can therefore increase the risk of filter blockage. This is not only a problem with the introduction of E5 but can also arise when switching from E5 to E10. This is particularly the case with B7, as methyl esters are an established class of degreasing agents.

Electrical conductivity and corrosion

Because of the molecular composition of ethanol and FAME, and their stronger association with water, E5, E10 and B7 have a greater electrical conductivity than standard petrol and diesel respectively (ethanol more so than FAME). The biocomponent present in the blend can increase the risk of corrosion in existing filling station systems from galvanic and electrolytic reactions where particular material combinations may be present. This can in turn increase the risk of filter blockage.

Preparation before the introduction of E5, E10 and B7

Metals, glass reinforced plastic (GRP), polyethylene, elastomers and composites are used as materials in equipment in filling station storage, pipework and dispensing systems. The deterioration of these materials can be exacerbated with the introduction of E5, E10 and B7 and also when switching from E5 to E10. Unless assurance has already been provided that the equipment on site (including valves, flanges, gaskets etc.) is compatible and of a suitable condition for E5, E10 or B7 the original equipment manufacturer should be contacted for advice.

Further information about the material compatibility of ethanol with filling station storage and dispensing systems can be found in the *EI/DFA Research report: Compatibility of materials used in distribution handling systems with ethanol and gasoline/ethanol blends*.

This information was produced by the EI's Service Station Panel, comprising service station engineering and operating experts with representatives from the major oil companies including, Artelia, BP, Certas, Shell, Tesco, Petrol Retailers Association (PRA), Downstream Fuel Association (DFA), Petroleum Equipment Installers and Maintenance Federation (PEIMF), Forecourt Equipment Federation (FEF), Federation of Petroleum Suppliers (FPS), United Kingdom Petroleum Industry Association (UKPIA) and the Environment Agencies

Checklist for filling station operators

Before the introduction of E5, E10 and/or B7					
Item	Action	E5	E10	B7	
Storage	Prior to first delivery of E5 or E10, the residual ethanol-free petrol stock should be run down to a minimum; this action also applies to future deliveries of E5 or E10 into tanks containing any ethanol-free petrol	✓	✓		
	Where possible, obtain assurance from equipment suppliers that storage system and all metal plastic and rubber materials, as well as tank gauges, are compatible with E5 or E10 as appropriate.	✓	✓		
	With petrol, ensure the storage tank and associated equipment are free of water and that deposits and sediments are removed from the tank bottoms and walls; cleaning to be carried out by a specialist contractor if required.	✓	✓		
	With diesel fuel, ensure the storage tank and associated equipment are free of water, deposits and sediments and check for any evidence of microbial growth; tank cleaning to be carried out by a specialist contractor if required.			✓	
	Confirm that the storage tanks, adaptors and fittings are in good condition, watertight and compatible with the specific biofuels to be used.	✓	✓	✓	
	For steel storage tanks with a liner, confirm the liner is in good condition and compatible with biofuels	✓	✓	✓	
	For tanks made of GRP, ensure it is in good condition and compatible with biofuels.	✓	✓	✓	
	Check filters throughout tank storage system to make sure they are in good condition and clean/replace as required.	✓	✓	✓	
	Dispensing	Obtain assurance from equipment suppliers that all metal, plastic and rubber materials in the dispensing system are compatible with the fuel being introduced.	✓	✓	
		Check dispenser flow rates to ensure there are no problems associated with microbial growth or particulates and also check that the cut-off mechanism in the nozzle is functioning properly.	✓	✓	✓
Check filters in dispensers to make sure they are in good condition and replace as required.		✓	✓	✓	
Check that the filters are suitable for use with biodiesel; water separating and coalescing filters should not be used.				✓	
Housekeeping	Check the tank gauges to make sure they are in good order and compatible with biofuels	✓	✓	✓	
	Develop an effective water management procedure with regular monitoring of water levels using the tank gauges and reduce water alarms to minimum detectable levels.	✓	✓	✓	
	Ensure an active and efficient wetstock programme is in place to monitor any leaks or water ingress into storage tanks as well as protect the environment in terms of soil, groundwater and surface water protection.	✓	✓	✓	
	Develop a procedure with a specialist contractor for regular maintenance of tank, pipework and filter inspections as well as checks of all tank fittings and associated equipment to ensure no leaks, water, or corrosion.	✓	✓	✓	

Checklist for filling station operators (continued)

	Monitor condition of storage tanks and associated pipework to check for evidence of microbial growth. This can be done by: a) Periodic microbiological test of samples from delivery nozzles and tank bottoms using field kits (e.g. IP 613) or laboratory methods (e.g. IP 385). b) Visual inspection of pump filters for microbial sludge. c) Video inspection by specialist contractors e.g. using borescope equipment.			✓
Environmental	Confirm the oil/water separator system is in good order, with a means to close the outlet in the event of a large spill, and that all materials are compatible with biofuels.	✓	✓	✓
	Obtain assurance that the oil/water separator is capable of handling E5 and/or E10 fuels and is compliant with existing permits and confirm that existing discharge parameters are in line with permits.	✓	✓	
	Check that the leak detection system is in good condition and fully operational.	✓	✓	✓
Health & Safety	Review and update site health and safety records and procedures as necessary.	✓	✓	✓
	Confirm the fire extinguishers are suitable for use.	✓	✓	✓
Dispenser Labelling	Ensure the E10 dispenser is correctly labelled in accordance with BS EN 228.		✓	
After the first delivery of E5, E10 or B7				
Sampling	Take a sample of fuel from the dispenser. If there is any marked discolouration or cloudiness, ensure that a thorough inspection of the tank and other equipment has been carried out. A review should also take place with the fuel supplier. If appropriate, a specialist contractor should be engaged to undertake cleaning of the fuel storage and dispensing system and check for any equipment malfunctions.	✓	✓	✓
Housekeeping	Tank gauges should be carefully checked to ensure that no separation has occurred.	✓	✓	✓
	Wetstock management service company should be contacted to advise about any grade changes.	✓	✓	✓
Continuing deliveries of E5, E10 or B7				
Storage	Carry out maintenance checks on a regular basis.	✓	✓	✓
	Ensure there is an effective system in place for equipment inspections covering the following items: a) Fill pipes, adaptors, fittings and associated equipment to confirm they are watertight. b) Metal, plastic and rubber hardware and fittings to confirm they are in good order and there are no signs of deterioration due to incompatibility. c) Internal condition of storage tanks to identify any problems due to corrosion, deposit build-up or microbial growth. d) Filters throughout tank storage system to make sure they are in good condition and clean/replace as required. e) Oil/water separator system to confirm it is functioning properly and capable of handling E5 and E10 fuels and that any waste disposal is in line with current permits and legislation.	✓	✓	✓

Checklist for filling station operators (continued)

	Monitor tank gauges and identify any problems with free water in tank bottoms. If water is detected there is an immediate risk of water separation with ethanol/petrol blends. The tank should be closed and a specialist contractor should carry out remedial works.	✓	✓	
	Monitor tank gauges and identify any problems with free water in tank bottoms with biodiesel blends, if water is detected a specialist contractor should carry out remedial works.			✓
	Monitor condition of storage tanks and associated pipework to check for evidence of microbial growth.			✓
	For steel storage tanks with a liner, consider using a specialist contractor to regularly inspect the condition of the lining to identify any material failures which could lead to tank leakage and environmental problems.	✓	✓	✓
Dispensing	Implement regular maintenance checks by a specialist contractor to check that all metal, plastic and rubber hardware, pipework and fittings are in good order and there are no signs of deterioration	✓	✓	✓
	Check filters in the dispensers to make sure they are in good condition and clean/replace as required.	✓	✓	✓
	Check the condition of dispenser nozzles and function of the cut-off mechanism to ensure the filters remain clean enough to retain line pressure, adequate dispenser flow rates and cut-off function; if build-up of microbial deposits on filters is suspected, a specialist contractor should carry out remedial action.			✓
Housekeeping	Ensure that tank gauges are functioning properly.	✓	✓	✓
	Wetstock management reports should be monitored to confirm no product losses or water ingress	✓	✓	✓
	Implement regular maintenance with a specialist contractor of tank, pipework and filter inspections as well as checks of all tank fittings and associated equipment to ensure no leaks, water, corrosion or microbial deposits.	✓	✓	✓
	Consider engaging a specialist contractor to carry out a preventative maintenance tank cleaning programme to avoid problems due to microbial contamination resulting in major filter blocking problems.			✓
Environmental	Ensure a spill kit is available to staff and provide spill kit contents checks. Staff should be trained to use the spill kit and spill training exercises undertaken.	✓	✓	✓