BIODIESEL – TANK AND STORAGE

This leaflet should provide you with guidance on legal regulations and how to proceed with the storage of biodiesel, fuels mixed from diesel and biodiesel, and bio heating oil.

It is recommended to use biodiesel as a liquid energy carrier in nature conservation areas and the areas protected against sewage pollution, because biodiesel does not have hazardous material properties. Due to its floating property, biodiesel is classified as WGK I, only slightly hazardous to water.

Biodiesel or FAME (Fatty Acid Methyl Esters) consists of fatty acid methyl esters of different chain lengths. Due to the chemical and physical properties of FAME (polarity, functional groups, oxidation stability) it is necessary to maintain consistent quality assurance measures. Proper storage has a decisive influence on the quality of biodiesel.

The basics

Tank and storage installations in which combustibles, flammable or highly flammable materials (or mixtures thereof) are stored or transferred are treated as areas requiring supervision and subject to the BetrSichV[1] regulation, which in most cases envisages, among others, regular checks and the possibility of withdrawal of the authorization by the competent control authorities. Although pure biodiesel (B100) does not qualify as a dangerous substance, these and further provisions are valid for mixtures of diesel and biodiesel or bio heating oil.

For the assessment related to the commissioning and setting up of the tank, the WHG[2] – and the AwSV[3] regulation are of decisive importance for water hazard materials. The AwSV ordinance provides for the general obligation of a specialist company (Fachbetriebspflicht) for installations with a total volume of over 1,000 liters. All technical rules (TRwS[4], list of construction rules and standards) are defined as commonly recognized technical rules. In addition, depending on the location and volume of tanks, it is also obligatory to report and control them. For the storage of fuels, the principle is that in the case of a permitted mixture, the requirements for storing a fuel component with the higher water hazard class, in this case diesel fuel or heating oil, must be respected. The installation marking is an important component of the safety markings for hazardous materials and is legally prescribed on the tank (or in the exposed area).

Above-ground and underground tanks

Basically, only tanks that have pattern approval or are compliant with the standard in the list of building rules (or from VV TB[5]) (§ 33 of the BImSchG[6]) can be operated. The corresponding lists must be clearly assigned to a given tank. Safety devices such as overfill protection (maximum value limiter), leak indicating devices, liquid alarm detectors in collecting containers or all installed components must have proof of their suitability in accordance with construction law. Overground tanks, regardless of their volume, must be constructed either with double walls and have a leak indicator, or they must be placed in a sufficiently large, airtight and durable room. In the case of aboveground tanks (capacity < 1,250 liters), overfill protection or the maximum value limiter are not obligatory if it is filled using the self-locking hose end. Underground tanks must always have a double wall and be equipped with a leak indicator and fill level bar. Underground tanks of all sizes must be controlled at their commissioning, withdrawal from use, in the event of significant changes and at regular time intervals. All installations or parts

of installations that are partly or completely embedded in the ground are considered to be underground. All other installations (also in accessible underground rooms) are considered to be above-ground.

Construction material for tanks

In general, it should be taken into account that all used materials are appropriate for tanks, seals and construction products (construction products regulation, list of construction rules), as well as for the use of biodiesel or biodiesel mixtures. The manual DIN-Taschenbuch 183 *Containers for liquids that are hazardous to water, flammable and non-flammable,* cites different standards for tanks. From DIN EN 12285-1, containing a list of positive liquids for steel tanks, it can be read that all steels are suitable for biodiesel storage. In addition, various polymeric tank materials such as polyamide (PA), polyetheretherketone (PEEK)[7] and fiberglass reinforced plastic (GRP)[8] are suitable for biodiesel storage. Copper and other non-ferrous metals, or their alloy are in a complete tank and pipe system useful only under certain conditions and should rather be replaced.[9] This action aims to avoid corrosion, the formation of metal soaps and a negative impact on a long-term stability, which could deteriorate the quality of fuel and propellants. In addition, tanks or galvanized containers are not appropriate from the point of view of today's technology. Galvanic anodes must be removed before filling with biodiesel.

Pipes

In the area of the tank, pipelines are usually made of carbon steel. Attached or installed parts of colored metal (copper, brass, bronze) or galvanized materials should be replaced with equivalent parts made of steel or aluminum or be dismantled, if possible and acceptable from a functional point of view. In the area occupied by fuel oil, copper pipes are often found as suction pipes. The use in a onepipe system should be perceived as less critical.[10] However, copper wires should be replaced as much as possible with steel pipes. It is not advisable to use biodiesel in a double pipe arrangement with copper pipes, where unburnt fuel goes back to the tank. Such a system should be switched, according to the accepted technical rules, to work in a one pipe arrangement.

Seals

Already at the beginning of biodiesel use, compatibility problems were found when using existing EPDM and NBR seals. Due to their polar nature, biodiesel molecules deposit in these plastics and cause swellings leading to leaks. Sealing materials and membranes were identified as appropriate plastics for fluorinated rubber materials such as FKM, FFKM and PTFE as well as PA and HDPE.[7,8,11]

Sealing surfaces and drainage devices

For safe storage, the correct functioning of the sealing surfaces (stones/joints) is essential. They should be checked visually, however any damage should be immediately removed in a professional manner.

Based on the documentation, please check whether the sealing materials (paint primer and sealing tape) and concrete stones for the upstands are suitable for use in the case of biodiesel. This also applies to diesel fuels with a higher proportion of biodiesel. Some paint primer for seals are not resistant to biodiesel or they undergo decomposition later. Stones with a layer of delicate mortar applied separately proved to be useless in a long-term exploitation.

In addition, for the use of biodiesel, check installed light liquid separators and other evacuation devices – according to the type/size of materials used. The settings should be made at an apparent product density of 0.95 g/cm^3, so that the automatic shut-off device works properly and the separator can be used as an additional retention volume. The standards EN 858-1 and EN 858-2 and DIN 1999-101 relating to light liquid separators with a certain biodiesel content should be used. In general, for new installations and changes, the manufacturers of construction products or a specialist plant should be consulted.

Cleaning, tank check

Although under the statutory regulations, checks of the tank are generally only necessary after 5 years (and do not necessarily imply prior purification of the tank), in the interest of preserving good biodiesel and avoiding product liability tanks should be cleaned every 2 years. The existing control obligation (Prüfpflicht) is regulated by the AwSV. When cleaning and checking the tank, it is especially necessary to check for corrosion pits and deformation of the tank walls or changes in the tank material. If a coating is used, it should be checked for a biodiesel-proof property.

Biodiesel storage

When storing fuel and propellants, and thus also biodiesel, the common rules of "good house-keeping" included in the guide of good system maintenance – DIN CEN/TR 15367-1 must be observed.

When biodiesel is stored, it is also necessary to pay attention to the high output quality of biodiesel. The most important quality parameters for biodiesel storage include oxidative stability and water content.

Ensuring oxidation stability
The addition of appropriate stabilizers to biodiesel usually takes place in the production process and is necessary for safe storage in order to achieve the required oxidation stability of 8 hours. If storage is to be carried out over a longer period, it is reasonable to increase the stability beyond the required minimum of 8 hours. It is possible to use additives with old biodiesel, however, the stabilizing properties of the additives may be reduced significantly.

Acid number
The corrosive effect of free fatty acids is small. However, due to the aging process, the acid number of FAME during storage may increase, due to which it is not possible to completely rule out the impact on metal structural parts. However, under conditions free of non-ferrous metals, this effect is almost imperceptible.

Low water content

The hygroscopic properties of biodiesel lead to the fact that during storage, water can be absorbed from moisture contained in the air. Pure biodiesel can physically dissolve up to 0.150 % (m/m) of water (EN 14214: max. 0.050 % (m/m)). At lower temperatures, primarily in mixtures with non-polar fuels, a free aqueous phase can be formed. Free water causes corrosion and serves as a nutrient solution for microorganisms, which in turn create biofilms.[12] In order to avoid free aqueous phase, always fill storage tanks in such a way that only a small volume of air remains. Before filling with biodiesel, tanks should be as clean and dry as possible. The use of a water separator should also be considered. It is practically impossible to store biodiesel so that it does not come into contact with water (moisture). Based on the above-described properties, AGQM sets stricter requirements to be followed by its members (producers: max. 0.027 % (m/m), traders: max. 0.032 % (m/m)). In general, it should be noted during storage that contamination with other fuels, and in particular the introduction of water into the product, can be excluded by appropriate measures.

All these parameters are regulated by EN 14214 standard. Further information on these and other important quality parameters can be found in the leaflet Biodiesel Analytics.

Cold and dark conditions

Generally, all fuels and propellants should be stored in cold and dark conditions. All reactions leading to the deterioration of the quality of liquid energy carriers proceed faster at elevated temperatures. This should be avoided by cold storage. Degradation induced by light leads to faster aging of fuels and propellants and there fore should be excluded.

Research projects have shown that long-term stability under good storage propellants conditions and with sufficient addition/stabilization of B100 can be over six months, and in the case of B20 mixtures many years.[13,14] If storage out of prescribed conditions is expected (e. g. in emergency aggregates, network replacement devices), the use of biodiesel or mixtures with biodiesel is discouraged.[15]

1 BetrSichV – Regulation on operational safety – German implementation of guideline 2009/104 / EG.
2 WHG – Water Ressources Act
3 AwSV – Ordinance on Installation for the handling of water hazardous substances
4 TRwS – Technical rules for water hazardous materials; TRwS 791 for installations using fuel oil
5 VV TB – Administrative provision of Technical Requirements for Construction Works
6 BImSchG – Federal law on protection against emissions
7 Bürkert Fluid Control Systems – durability table
8 Institute of Heat and Oil Techniques e. V., Project Resistance of materials, 2009
9 DGMK e.V. - Project 729
10 Institute of Heat and Oil Techniques e. V. – construction parts of oil fuelling
11 DGMK e.V. - Project 780
12 DGMK e.V. - Project 770
13 R. L. McCormick, E. Christensen, Fuel Processing Technology, 128, 2014, 339 – 348.
14 DGMK e.V. - Project 714
15 German Federal Office of Civil Protection and Disaster Assistance– emergency power supply in enterprises and public authorities

All presented standards have been published by Beuth-Verlag and can be obtained there (www.beuth.de).

Note

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