A White Paper from the European Data Centre Association Technical Committee

Data Centres Fuel Storage
Contamination and Prevention

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Executive Summary

The European Data Centre Association (EUDCA) represents the interests of the European commercial Data Centre operator community, both politically and commercially. Established in 2011, the association is registered under Belgian Royal Charter and is run by its members, for its members. Our aim is to streamline the available information into a clear understandable format, to support you in your processes.

The reliable performance of backup generator installations is critical. This paper explores issues related to fuel storage and polishing in data center facilities and how appropriate action can reduce the possibility of a generator startup failure. Technical parameters for the implementation of fuel polishing and storage have been analyzed and constructional instructions for the proper installation are presented.

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Introduction

Power generators are an integral part of data center facilities and ensure availability of power to the critical equipment. Most of the generators consist of diesel-powered internal combustion engines. Their operation requires the availability of diesel which in turn requires appropriate long-term handling and storage. TIER certification requires the storage of diesel capable of supplying the generators for at least 12 hours.

The European Committee for Standardization published the EN 590 standard that describes the physical properties of diesel fuel sold in European Union. According to EN590, diesel fuel is allowed to consist of 7% fatty acid methyl ester (biodiesel) and 93% conventional diesel. The biodiesel content described in E590 can be expected to stay in a useable condition for 12 months at an ambient of 20°C and can present a challenge in terms of storage and fuel polishing procedures for data centers.[1][2][3]

Background

a) Biodiesel content influence

Biodiesel is a renewable fuel blending component derived from lipid feedstocks such as vegetable oils and animal fats. Triacylglycerols are converted to mono-alkyl esters via transesterification with methanol to produce a material that has properties more closely resembling those of diesel fuel than the lipid feedstock. Much like the vegetable oils and animal fats from which biodiesel is derived, the presence of unsaturated components leads to susceptibility to oxidative degradation. The points of unsaturation on the biodiesel molecules can react with oxygen, forming peroxides that break down into acids, sediments, and gums. [2]

b) Microbial Contamination

Microorganisms are present everywhere in various forms: molds, yeasts and bacteria. Their uncontrolled multiplication inside a diesel tank can become a serious problem, because it will give a rise to the formation of sludge and slime. The microbial growth is only possible in the presence of water without which they are not able to survive, or they enter into a sleeping phase.

c) Exposure to heat

L. M. Du Plessis, J. B. M. De Villiers and W. H. Van Der Walt were the first to study the storage stability of biodiesel. They monitored the production of acids, peroxides and aldehydes over a period of 90 days. They found that exposure to heat and air greatly accelerated degradation of biodiesel, but when stored at 20 °C in closed containers or stored after the addition of an antioxidant, the biodiesel remained stable. [4]

d) Exposure to metals

Certain metals such as iron, rust, copper, brass, bronze, lead, tin and zinc will accelerate the degradation process and form even higher levels of sediment. Biodiesel should not be stored in systems that contain these metals.[5]

Acids, sediments and gums represent a serious threat concerning clogged diesel filters, clogged nozzles and damaged high-pressure diesel pumps. Failures of any of the above parts could lead to generator failures and potential downtime.

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Prevention & Maintenance Practices

The need to reduce our dependence on fossil fuels necessitates the use of biodiesel. In order to store biodiesel efficiently, effort has been made to develop appropriate prevention and maintenance practices.

a) Preventative Maintenance

In order to be checked and verified the quality and the oxidation level of the stored diesel, chemical analyses are carried out. For each new fuel receipt, a full chemical check of the fuel should be performed to ensure that adulterated fuel or diesel with high oxidation level does not enter into the tank. Furthermore, microbiological testing as well as fuel oxidation control is recommended every three months.

A regular schedule concerning the stored fuel maintenance should be established in order to ensure that water and dirt is drained from the tanks. The frequency of the specific works should be at least monthly and depends on the tank's tendency to collect water. The schedule should also include a total fuel replacement and a tank cleaning every specific number of years, depending on the regular chemical analysis results.

b) Chemical Additives

Although only limited research has been done on the issue of chemical additives, tests indicate that unless biodiesel used within a few months, it should be stabilized with antioxidants in order to reduce susceptibility to oxidation and degradation. [3][5]

Fungus and bacteria are usually growing in diesel tanks where water contamination is observed. Biocides are recommended for fuels wherever biological growth in the fuel has been a problem. Biocides work equally well for petroleum diesel and biodiesel blends, because they work in the water phase. Biocides/Fungicides are only effective on fungus and bacteria and will not stop other oxidation reactions from taking place. The doses of the fungicide depend on the presence or not of fungi inside the tank. If fungus is present, then a kill dose is required. Otherwise a maintenance dose is used to stop fungus growing. [3][5]

Concerning the kill dose, killing the fungus can lead to a built up of dead matter which may block the filters or other diesel circuit components. Ideally, any chemical addition should be followed by tank drainage.

c) Fuel Tank & Components

Fuel tanks and the components connected to the diesel circuit should be made of heavy-duty polyethylene material or stainless steel. A study conducted by the department of Chemical Engineering in the McMaster University of Canada, demonstrated that that biodiesel blends stored in polyethylene fuel tanks were stable for 380 days when held at 23 °C [6].

The installation of the tank requires a general secondary containment when it is not under the direct oversight or control of facility personnel. The specific secondary containment (for example, dikes or catchment basins) must hold a minimum 100 percent of the capacity. An alternative to secondary containment is to provide a double skin tank, capable to collect lost fuel. Monitoring of the annulus using specific analyzers can alert operators to leak problem.

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Sediments and gums formed inside fuel tanks are extremely difficult to remove even with the use of strong corrosive chemicals. Fuel tank geometry should be such as to allow its internal cleaning by friction. The existence of a manhole at the top of the tank is needed.

Tanks should have a well-defined low point where water will collect and can be drained. Typical example consists tanks that are coned shaped at lower level.

Temperature and humidity are inseparably linked and play a major role in choosing the installation location of the tank. The abrupt temperature changes could cause moisture creation inside the tank. Moisture from condensation will increase the oxygen level into the tank and create a favorable environment for biodiesel to react and form sediments and gums. In order to avoid the moisture creation, the factors that affect temperature variation should be considered. Breather filters which can capture moisture should also be installed at all air entry points into the tank, in order to prevent moisture insertion.

d) Fuel Polishing System

Diesel fuel polishing is the maintenance process that stops water and contaminants impacting fuel quality while it's held in storage tanks. The installation of a fuel polishing system aims to maintain the stored diesel at optimum quality. It is important to emphasize that replacing diesel is a costly process as the diesel is considered as hazardous waste. Its collection and treatment is made by specific certified recycling plants.

The polishing procedure uses pumps in order to recirculate the stored diesel and filters that are capable of removing the water molecules and the tiny particles before they grow large enough to cause problems. The key points of the polishing system installation are:

- The system should pump diesel from the bottom of the tank, process it and then return it to the top of the tank.
- The pumping capacity of each pump depends on the amount of stored diesel into the tank and the desired recirculation time of the total diesel volume. The installation of a pump capable of recirculating the total amount of diesel, in one-week period, is suggested.
- The micron rating and the efficiency of the filters. As microscopic abrasive particles 5-10 micron could cause damage to engine parts such as injector plungers, it is suggested that the installation comprises of a set of three filters (30 micron including a water separator, 10 micron and 2 micron).[7]

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Conclusions

This paper explains the different type of risks concerning the storage of (bio)diesel in Data Center facilities. At the same time, it presents the key safe storage and diesel management processes in order to achieve maximum availability of diesel fuel to the backup generators. Briefly:

- The proper installation, location, and geometry of diesel fuel tank, as well as the proper materials for all components that are used for fuel distribution, is one of the most critical parameters for the long-term fuel storage.
- Fuel storage requires a preventive maintenance program, providing a useful tool to the operations personnel concerning the bio-diesel degradation. Preventive maintenance program should include regular chemical analysis, use of chemical additives, and fuel polishing.
- A permanent installation of a system for fuel polishing in order to perform continuous polishing cycling operation is recommended.
- Care should be taken regarding chemical additives. Research indicates that their addition will help to store biodiesel for longer than 6 months and up to several years. At the same time, special treatment may be required because of their addition.

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References

[1] EN590, Retrieved from: https://en.wikipedia.org/wiki/EN_590.

[2] Earl Christensen, Robert L. McCormick, Long-term storage stability of biodiesel and biodiesel blends, Fuel Processing Technology, Volume 128, December 2014.

[3] BP NEWS, Long Term Storage of Diesel ADF1403, February 2005.

[4] L.M. Du Plessis, J.B.M. De Villiers,W.H. Van DerWalt, Stability studies onmethyl and ethyl fatty acid esters of sunflower seed oil, Journal of the American Oil Chemists Society 62 (4) (1985) 748–752.

[5] Biodiesel Handling and Use Guide, Fifth Edition, U.S Department of Energy, November 2016.

[6] M.R. Thompson, B. Mu, C.M. Ewaschuk, Y. Cai, K.J. Oxby, J. Vlachopoulos, Long term storage of biodiesel/petrol diesel blends in polyethylene fuel tanks, Fuel 108 (2013) 771- 779.

[7] Fuel Contamination Control, Caterpillar USA, 1997,