Biodiesel B50: New Challenges and Strategies for Maintaining Fuel Quality

A Practical Guide to Fuel Storage Management, Testing, Filtration, and Fuel Polishing for Reliable Fuel System Performance.

Since July 1, 2026, Indonesia has begun implementing B50, a fuel blend containing approximately 50% FAME (Fatty Acid Methyl Ester) and 50% petroleum-based diesel. This change is not simply a matter of altering the fuel composition. The higher FAME content also affects fuel behavior during storage and use, particularly in terms of water, oxidation, and its ability to dissolve existing deposits inside storage tanks. Therefore, a tank that was previously suitable for B30 or B40 may not remain in the same condition when transitioning to B50.

For tank operators, maintenance teams, generator operators, and facilities in industrial, mining, marine, and data center applications, these changes need to be anticipated through more systematic fuel management. Fuel quality cannot be assessed based on visual clarity alone. Very small contaminants, dissolved water, microorganisms, and sediment at the bottom of the tank can develop unnoticed until they eventually affect filters, pumps, injectors, and overall engine reliability.

Why B50 Requires More Careful Fuel Management

FAME is hygroscopic, meaning it is more prone to absorbing and retaining water than conventional diesel. Water in the tank can exist in three forms: free water, which settles at the bottom of the tank; emulsified water, which is dispersed throughout the fuel; and dissolved water, which is dissolved in the fuel and cannot be detected visually. The presence of water can accelerate corrosion, reduce lubricity, and create conditions that promote microorganism growth.

B50 is also more susceptible to oxidation. Under clean, dry, and cool storage conditions, the fuel can remain stable for approximately 3–6 months. However, degradation can occur more rapidly when storage conditions are less than ideal. This degradation can produce organic acids, gum, sediment, and other contaminants that may interfere with fuel system performance.

Another characteristic that requires attention is solvency. When B50 is introduced for the first time, deposits that have accumulated over years on tank walls and at the bottom of the tank may be loosened. These materials can then be carried along with the fuel flow, increasing the contaminant load on fuel filters. As a result, filter clogging during the initial weeks of B50 use may be caused by loosened legacy deposits rather than solely by the quality of the new fuel.

Clean Fuel Is Critical for Modern Diesel Engines

The development of modern diesel injection systems has increased the need for cleaner fuel. Modern common-rail systems can operate at pressures of up to approximately 2,400 bar, with injector nozzle openings as small as 2–3 microns. Particles that are invisible to the naked eye can wear injector components, alter the spray pattern, reduce combustion quality, and accelerate performance degradation.

Water can also cause significant problems within the fuel system. In addition to promoting corrosion in tanks, piping, pumps, and other metal components, water can reduce lubricity, leading to increased injector wear. Under certain conditions, water can also support the growth of microorganisms, resulting in sludge and biofilm formation.

Therefore, fuel cleanliness should not be assessed based on visual inspection alone. The technical guide uses ISO 4406 as one of the references for classifying particle contamination levels. ISO 18/16/13 represents the maximum particle contamination level specified by the Worldwide Fuel Charter, while lower values indicate cleaner fuel. The actual cleanliness target should still be adjusted according to the application requirements and the engine manufacturer's specifications.

Three Main Sources of Contamination to Control

The first is water. Water can enter through condensation caused by temperature changes, fuel introduced during distribution, rainwater entering through manholes or breathers, or changes in conditions that cause dissolved water to separate into free water. Free water settling at the bottom of the tank creates an ideal environment for microorganism growth.

The second is microorganisms, often referred to as diesel bugs. Microorganisms can live in both the water and fuel phases and form biofilm on tank surfaces. Indonesia’s warm tropical climate, combined with the presence of water, can increase the risk of bacterial, mold, and yeast growth. Once biofilm has formed on tank walls, it cannot be removed through filtration alone.

The third is solid particles, such as dust, sand, rust, fibers, wax, asphaltenes, and carbon deposits. These contaminants can originate from filling operations, corrosion, existing deposits, or fuel distribution. Particles can settle at the bottom of the tank and become resuspended when the fuel level changes or the tank is subjected to vibration.

From Fuel Testing to a Comprehensive Fuel Management System

B50 fuel management should be implemented as a Fuel Management System, an approach that covers the entire fuel cycle—from receiving and storage to monitoring and final use by the engine. This approach consists of five key elements: testing, cleaning, protection, monitoring, and documentation.

Fuel testing serves as the basis for informed decision-making. For static storage, testing is recommended at least every six months and may be conducted more frequently for critical facilities. During the transition from B40 to B50, the guide recommends testing at three-month intervals. Samples should be collected from the top, middle, and bottom of the tank, as fuel conditions can vary at different depths, particularly when water and sludge accumulate at the bottom.

Key parameters that can be assessed include particle count according to ISO 4406, water content, microbial activity, FAME content, and wear metal content. Testing can be performed through third-party laboratory services, independently using portable equipment, or through a hybrid approach. Self-Service Testing allows certain results to be obtained within minutes, while parameters such as microbial activity and wear metal content still require laboratory analysis.

Fuel Polishing as Part of Contamination Control

A Fuel Polishing System is a process for restoring fuel quality through continuous circulation and repeated filtration until the targeted cleanliness level is achieved. Depending on the type and micron rating of the filters used, the system can reduce free water, emulsified water, suspended solid particles, and microorganisms. However, dissolved water and biofilm that has adhered to tank surfaces cannot be completely removed through this process. If biofilm has already formed, tank cleaning should be performed before fuel polishing.

Fuel polishing systems can be configured as a kidney-loop system, in which fuel is filtered and returned to the same tank, or as a transfer system, in which fuel is transferred to another tank after filtration. The system can also be integrated into the fuel receiving process to prevent contaminants from entering the storage tank in the first place.

System selection should consider tank volume, flow rate, pump distance and head, contamination level, filter type, and operational requirements. Filters are available in 3-, 6-, 10-, and 25-micron ratings. A multi-stage filtration system can be used to capture larger particles first before the fuel passes through finer filters. For water removal, the filtration media can be selected between a water absorber or coalescer, depending on the fuel condition and application requirements.

Practical Steps for Managing B50

B50 management does not end after fuel polishing. Main storage tanks should ideally not hold B50 fuel for more than approximately six months, while fuel in day tanks is recommended not to remain stagnant for more than three months. After the equipment has finished operating, keeping the tank full can help reduce headspace and minimize the potential for condensation. Tanks should also be properly sealed and, where possible, equipped with a breather to reduce moisture ingress from the surrounding air.

During the initial stages of B50 implementation, special attention should be given to fuel filters, as accumulated deposits may become loosened. The guide recommends replacing fuel filters earlier and shortening the replacement interval to approximately 50% of the normal interval for the first few cycles. Once the system has been confirmed to be clean, the standard replacement interval can be resumed. Keeping spare fuel filters on-site is also important for facilities where high operational reliability is critical.

Conclusion

The implementation of B50 changes how fuel needs to be managed within storage tanks. The higher FAME content makes the control of water, oxidation, deposits, microorganisms, and solid particles increasingly important. Maintaining good fuel quality not only protects filters and injectors but also helps reduce the risk of unplanned downtime and maintenance costs.

An effective strategy is to integrate periodic testing, proper storage practices, water control, filtration, fuel polishing, monitoring, and documentation into a comprehensive Fuel Management System. Before taking corrective action, the actual condition of the tank and fuel should be assessed through proper sampling and testing. With a data-driven approach, operators can determine whether a facility requires routine monitoring, fuel polishing, enhanced filtration, tank cleaning, or other corrective measures.