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Biocide Product Comparisons: Bellicide vs Biobor JF

The following is a comparative analysis between two popular biocides – Bellicide (Bell Performance) and Biobor JF (Hammonds Industries). The intent of this comparison is to illustrate the key differences between the two biocide products, to enable the consumer to make the best decision for them.

Biobor JF and Bellicide: Introduction and Background

Biobor JF was first manufactured by U.S. Borax in 1963 and is now manufactured and distributed by Hammonds Industries. Today, Biobor JF is perhaps the most well-known biocide in the marketplace and touts numerous engine and equipment manufacturer recommendations. As such, there is a perception among consumers that Biobor JF is the best because it may be the only one they can recall hearing about.

A significant reason behind Biobor JF's extensive market share is the fact that it was the first biocide that was universally approved for use in jet fuel. This is where the 'JF' comes from. U.S. Borax and Hammonds have done an excellent job of leveraging this into additional recommendations. However, as we will show, market share and effectiveness do not always go hand-in-hand.

Since 2010, Bell Performance has offered its biocide solution Bellicide for stored fuel users needing an effective solution to knock out fuel microbial problems. Bellicide, not Biobor JF, is the best biocide on the market, and this is where we're going to show you why\.

Essential Characteristics for Biocides

What makes a good biocide treatment? The best biocide(s) should score highly in the following characteristics:

Kills quickly

Once mixed into the fuel or fluid, the most effective biocides will achieve the most complete kill rate in the shortest time. The best biocides (once properly mixed into the liquid so they can achieve contact with the microbes) can achieve a complete kill in as little as a couple of hours. It should be noted that quickness of total kill does depends on factors including the level of microbial contamination and the kinds of microbes being targeted.

Maintains a complete kill for the longest period of time

The best biocides will maintain their complete kill rates for the longest time possible. Of course, how long this may be maintained is somewhat situation-dependent. But the most effective biocides will, all other things being equal, maintain a high kill rate for as long as four weeks, sometimes longer. Less effective biocides lose their kill potency in shorter periods of time.

Resistance to pH changes

The best biocides will work equally well in both acidic (pH < 7.0) and basic (pH > 7.0) environments. Maintaining effectiveness in acidic environments is especially important because fuels and liquid with severe microbial contamination will tend to be acidic, due to the acids produced by microbial respiration as they grow and thrive in the liquid. So a biocide that is less effective in an acidic environment would not be a good choice.

Effectiveness in both fuel and water phases

This is essential when using a biocide in stored fuel. The presence of a water phase (a layer of water under the fuel) is always associated with microbial growth because microbes need the water phase to grow and thrive. Some biocides have reduced

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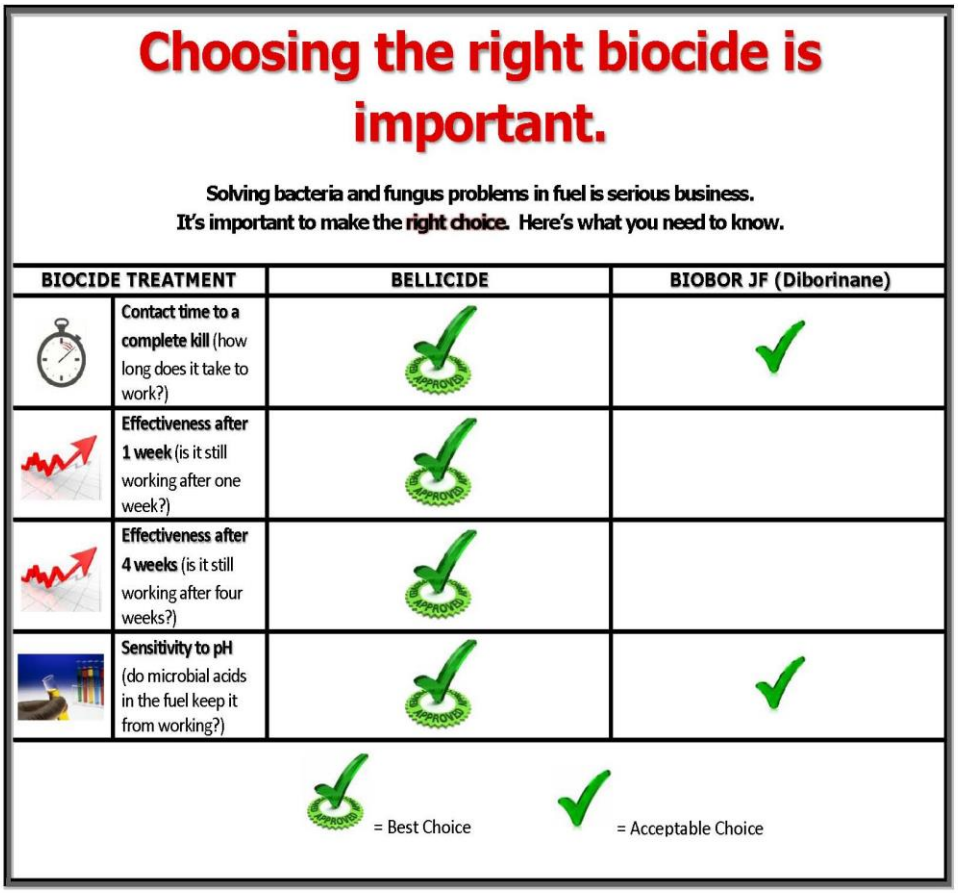
effectiveness in the presence of water because their active "biocidal" ingredients react with water and change into neutral components. This means that they may be effective at partitioning (moving) through the fuel phase on top and killing microbes at the interface of the fuel and water layers, but they can't do anything about the microbes that move in and travel through the water phase. The most effective biocides will be equally effective at killing microbes in both phases and will not lose effectiveness in the presence of water.

Low treat rate

Biocides offer benefits that have great monetary value to their users – the value gained from solving or preventing potentially costly problems. The best biocides should be effective at low treat rates, typically 1:5000 or better. The lower the treat rate, the more cost-effective they are to use. It should be noted that the effective treat rate that will be needed depends on factors including the level of microbial contamination and the kinds of microbes being targeted.

Bellicide vs. Biobor JF

Now that we've defined what separates a good biocide from a less-than-stellar one, we can compare Bellicide to Biobor JF with respect to performance in these critical areas.



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Summary of Biocide Comparison: Bellicide vs. Biobor JF

The above infographic gives a summary of how Bellicide and Biobor JF perform with respect to the most important attributes related to biocide efficacy. We start with the data not related to kill rates and timing.

Sensitivity to pH – Bellicide and Biobor JF are two of the better biocide chemistries in the marketplace that are least sensitive to pH levels of fuel or liquid.

Effectiveness in water phase – This is not listed on the infographic but should be commented on. Bellicide is very effective and retains its performance in the presence of water. Biobor JF, in stark contrast, is rendered less effective in the presence of water due to a reaction between the water and its active biocidal ingredient, reducing the active ingredient's presence in the water and, thus, reducing BioBor's effectiveness.

Attributes of Biocide Efficacy: Kill Studies Background

Because the purpose of a biocide is to kill microbes, the data relating to how fast and how completely it kills microbes is going to be the primary determiner of biocide value. Thus, the three remaining data points in the infographic comparison – *Contact Time / Effectiveness After 1 Week / Effectiveness After 4 Weeks* – are derived from the results of comparative kill studies conducted at independent testing laboratories.

Pertinent details on the comparative kill studies are listed here:

- Bellicide was tested in the laboratory to demonstrate its effectiveness against three other leading fuel oil microbicides. One of the three microbicides was Biobor JF.
- Multiple treat rates were used during the studies (100 ppm, 200 ppm, 300 ppm) to determine each biocide's level of effectiveness at killing different strains of microbes relative to treat rate.
- The test method used is contained in the SIM publication #2, "*Proposed Procedures for the Screening of Microbial Inhibitors in Hydrocarbon/Water Systems."*
- The microorganisms used in the study include the bacterium *Pseudomonas aeruginosa* (abbreviated as *P. aeruginosa* or *Ps. aeruginosa*) and the fungus *Hormoconis resinae* (formerly known as *Cladosporium resinae*, abbreviated as *H. resinae*). These microbe strains were selected because they are common contaminants in the field, they grow well in large numbers, and they grow well both in water and at the fuel-water interphase.

Kill Study Data

The data for kill effectiveness on the two microbe strains (*P. aeruginosa* and *H. resinae*) can be summarized by the charts below. The data is expressed in terms of percent kill (at 1 week and 4 weeks) of the total microbe count relative to the count in identical untreated fuel oil samples. For perspective, the average microbial count (between the two microbe strains) at 1 week in untreated fuel was about 6.4×10^6 per ml of fuel, and the average count at 4 weeks in untreated fuel was 6.0×10^5 per ml of fuel.

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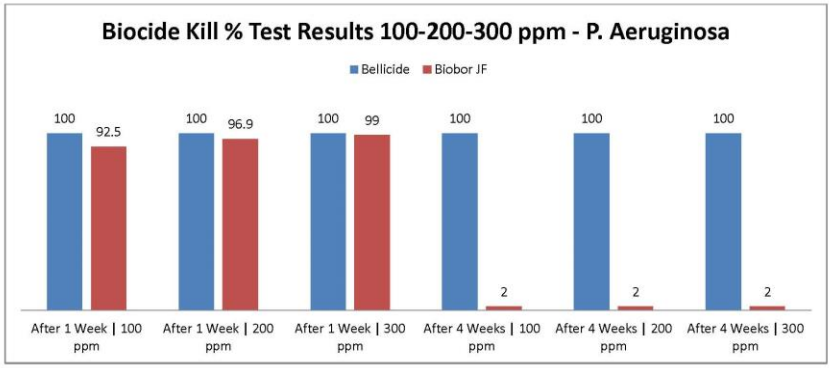
Kill Study Results Comparison – Multiple Treat Rates (100, 200 and 300 ppm)

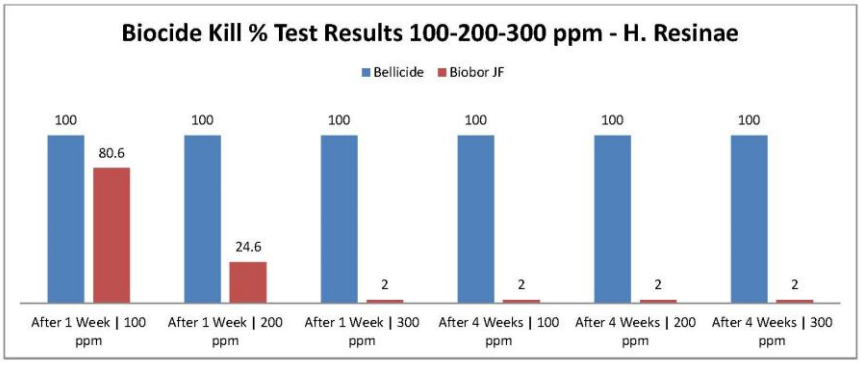


Results After 1 Week

- Bellicide maintained a full 100% kill rate at all treat rates (100, 200 and 300 ppm).
- Biobor JF was reasonably effective through 1 week at all treat rates. But Biobor JF lost almost all effectiveness before the conclusion of 4 weeks, even at the highest treat rate (300 ppm).

Results after 4 Weeks

- Bellicide maintained a full 100% kill rate at all treat rates (100, 200 and 300 ppm).
- Biobor JF lost almost all effectiveness before the conclusion of 4 weeks, even at the highest treat rate (300 ppm).



Results After 1 Week

- Bellicide was the only one to maintain 100% kill rate at all treat rates (100, 200 and 300 ppm).
- Biobor JF killed 80% after 1 week at the lowest treat rate (100 ppm), but saw its 1 Week effectiveness drop rapidly as its treat rate was increased to 200 and 300 ppm (which is the opposite of what one would expect).

Results after 4 Weeks

- Bellicide clearly performed best, as the only product to maintain full 100% kill rate after 4 weeks, even at the lowest 100 ppm treat rate.
- Biobor JF proved much less effective at maintaining kill effectiveness over 4 weeks, with kill rates approaching 0-2% even at the highest treat rate.

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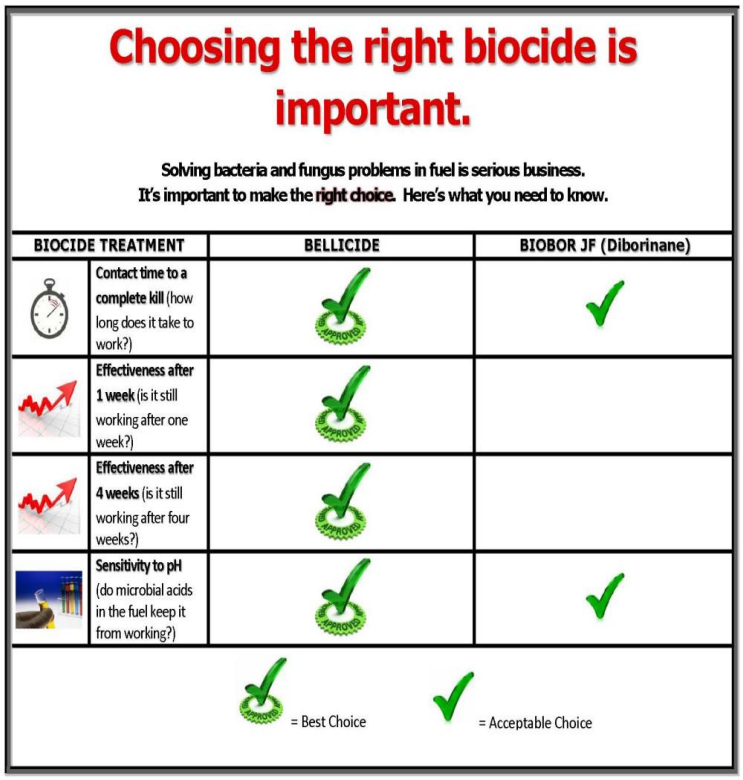
Kill Study Conclusions

The overall conclusion reached from this testing was that the Bellicide chemistry proves to be much more effective than Biobor JF. In these direct comparison trials, Bellicide was the most effective biocide at both killing microbes in the first week and (more importantly) maintaining a full kill for up to 4 weeks, both at the lowest treat rate (100 ppm).

Biobor JF was only sporadically effective at lower treat rates and proved ineffective, even at higher treat rates, at maintaining any kill rate up to 4 weeks, an essential trait for any good biocide.



Comments on Attributes of Biocide Efficacy

The above kill study data thus informs the conclusions on biocide effectiveness that were expressed in the previous infographic.

Contact Time to a Complete Kill – Market data shows that Bellicide achieves maximum microbe kill in as little as 2 hours. Biobor JF achieves maximum microbe kill in 4-6 hours.

Effectiveness After 1 Week – The kill study data was clear that Bellicide maintained the best level of 1 week kill effectiveness, outperforming Biobor JF by a significant margin.

Effectiveness After 4 Weeks – The kill study data was equally clear that Bellicide maintained its 100% kill rate for the longest period of the time – the entire 4 week test period. Biobor JF was markedly ineffective after 4 weeks.

Summary and Conclusion

- Bellicide kills faster and at a higher initial rate than Biobor JF.
- Bellicide maintains a complete kill rate significantly longer than Biobor JF.
- Bellicide does not lose effectiveness in the presence of water.
- Bellicide does a better job for significantly lower cost than Biobor JF.

It should be apparent from the data and the analysis that Bellicide is far superior to Biobor JF in meeting the most important criteria for an effective biocide. As noted before, Bellicide is the best biocide treatment in the marketplace.