



Biobor®JF Solubility and Blending

Patrick M. Eakins, Ph.D.
Technical Director
peakins@biobor.com

Hammonds Fuel Additives, Inc.
6951 W. Little York
Houston, Texas 77040

The ideal fuel biocide should be designed to carry the compounds throughout the fuel and fuel system. In order to achieve this goal, fuel solubility is critical. Equally critical is a biocide that efficiently partitions into any water phase present in the fuel. Biobor®JF is a fuel-soluble boron compound designed especially for use in aviation turbine fuel systems. It partitions into water in the fuel to make an effective microbial kill in both the fuel and water phase. It has the following characteristics:

Boron Content 7.4 wt.% Typical
Specific Gravity 1.05
Distribution Coefficient 228

Biobor®JF concentration in fuel is based on parts per million elemental boron by weight. This is done so the boron content of the fuel is easily determined. The concentrations of Biobor®JF of 135 to 270 ppm correspond approximately to 10 to 20 ppm elemental boron.

Biobor JF is readily soluble in all hydrocarbons. Solubility testing completed by University of Dayton Research Institute show Biobor JF is miscible (100% soluble) in fuel at typical treatment temperatures.

Temperature (°C)	Solubility Limit Biobor in Fuel	Solubility Limit Biobor in Water
-10	11.30%	ND
-5	16.60%	ND
0	33.70%	ND
5	33.70%	23.7%
10	34.10%	33.3%
21.2	Miscible	36.8%
40	Miscible	51.0%

The molecules can be best described as amphiphilic, having both hydrophilic and lipophilic qualities. The molecules are very stable and intentionally designed to be resistant to hydrolysis. Also, note that it is highly soluble in water. An effective fuel biocide must be dual phase soluble, capable working in both fuel and water phases. As designed, Biobor JF remains in the fuel until it comes in contact with water.

It is designed with a distribution coefficient to allow for the optimal amount of boron to partition into any water present and at the same time allow the right amount of boron to remain in the fuel for continued protection. This is especially important in consideration of complicated fuel system designs such as aircraft and generator belly tanks. Biocides that are wholly or mostly water-soluble create



problems that are overcome by Biobor®JF's unique molecules. While other, more water-soluble biocides often exhibit serious fuel solubility issues and as a result do not protect the fuel and fuel system adequately, Biobor®JF does both protecting the fuel while effectively working in the fuel and water phases.

In the very early stages of Biobor®JF's development it became necessary to develop an accurate understanding of how the biocide could be used to adequately protect aircraft. Over-the-wing blending became necessary to treat the aircraft when no other methods were available.

A large oil company called for help in alleviating a severe microbe-induced corrosion problem existing in their corporate jet. In discussing the method of applying Biobor®JF, it quickly became apparent that the operating schedule and location of the aircraft necessitated over-the-wing blending. The method prescribed involved adding the amount of Biobor®JF needed to treat the tank in three parts. A typical blending procedure entailed introducing the additive in increments as the aircraft was being fueled.

TABLE 1
Biobor®JF Distribution

Sample Code	Boron Content (PPM)		
	0 hr.	13 hr.	27 hr.
1-1	10		24
1-2	10		22
1-3	9		22
1-4	9	21	24
1-5	29		24
1-6	45	14	22
2-1	14		25
2-2	14	22	24
2-3	32	23	24
3-1	29		25
3-2	14	20	24
3-3	13	20	24
4-1	45	19	25
4-2	28		25
4-3	6		24
4-4	3	19	24
4-5	4		24
4-6	4		24
Left Aux. Fill	7	20	22
Left Aux. Drain	53	20	22
Right Aux. Fill	5	20	24
Right Aux. Drain	27	20	24



The original blending took place when the aircraft tanks were dry and the total amount of Biobor®JF needed to treat each tank was added after 100 gallons of fuel. The tanks were then topped off. Samples were taken from fuel probe access holes, drains and fuel caps. The results of the samples indicated Biobor®JF distributed very well and provided protection to the aircraft fuel system. The fact that the aircraft was stationary before the additive was sampled bore heavily on the moderate variance in concentrations. However, samples taken at 13 and 27 engine hours (Table 1) show that the distribution was uniform and provided protection throughout the wings. Samples were taken after the aircraft had flown and it is postulated that the aircraft movement provided some additional mixing. Evaluations show that with minimal blending, Biobor®JF effectively provided extremely uniform distribution.

Over the years, Biobor JF has been tested with little to no blending with the similar results. Because it solubilizes quickly and distributes throughout the fuel system with little to no agitation, it is the most effective fuel biocide for protecting complicated fuel systems.

CONFIDENTIAL & PROPRIETARY – This document is the property of or controlled by Hammonds Fuel Additives, Inc. and is not to be used or reproduced without written permission of Hammonds Fuel Additives, Inc. This document and copies thereof must be returned upon request and remains the property of Hammonds Fuel Additives, Inc.

SOL05052023