THE GAMGRAM

No. 28 **WSIM, MSEP AND SWIFT KIT** **APR. 1984**
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This is a totally revised issue of GamGram No. 28. Rewriting it became essential because during the 12 years since the original issue was published many changes have occurred.

The basic problem has been that the industry requires more exacting information, better test reproducibility and data that relate more closely to the filter separators that are being used in aviation today. This has resulted in the development of better test procedures and refined testing apparatus. The original title was "How to Measure WSIM".

Most jet fuel supply systems include a piece of equipment known as a filter separator. Monitor filters are also used but they are not the subject of this GamGram. Unfortunately, very few people know the conditions that must exist for the filter separator to do its water removal job properly. If the water could always be expected to lie in the bottom of a tank with the fuel on top, it would be a simple job to drain it away, and most operators do that regularly. But fuel with water in it that goes through a centrifugal pump becomes an emulsion of literally millions of tiny water drops that do not settle to the bottom of the tank for long periods of time. It is this emulsion that the coalescer elements in the filter separator must deal with. They must gather the tiny water drops together so that they will become large drops (coalesce) that can rapidly settle to the bottom and be drained away.

The enemy of a coalescer element is "surfactant" or surface active agents that prevent water drops from gathering together into large drops. They are chemical molecules that seek and influence a surface. The particular surface they "like" is the surface of a water drop in the fuel. The reason they like a water surface is because they have 2 "heads". One head likes fuel; the other head likes water. So, if the fuel contains surfactants and if water is present, those 2- headed molecules "zoom" to the surface of the water drop just like bees go for honey. The fuel "heads" orient themselves to stay in the fuel and the water heads are captured by the water. Ultimately, the entire water drop is surrounded by a surfactant film making it impossible for 2 water drops to coalesce together because they cannot come into contact.

In the early days of jet fuel handling, it became obvious that a test was necessary to find out if a batch of fuel was contaminated with surfactants to an extent that coalescer performance would be jeopardized. The Water Separometer Index (WSI) test was developed and after modification it became the WSIM test (pronounced "wiz-um"). A reading of 100 was excellent, meaning that coalescers would perform very well. If the reading was as low as 70 the fuel was considered very poor. Extremely contaminated fuel could be "zero".

The modern instrument that measures the surfactant contamination of the fuel is currently called the Micro-Separometer®. It is a highly refined version of the original equipment. The reading is still 100 for the best fuel but instead of referring to it as the WSIM rating, it is called MSEP (pronounced Em-sep).

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Both the WSIM and the MSEP equipment are based on the same idea; an emulsion of water and the fuel sample is forced through a pad of fiberglass coalescing media. An optical device measures the haze in the effluent. The less haze detected, the higher the rating and vice versa. While precision (repeatability) has never been very good for either test, MSEP has proven to be superior to WSIM. Another big problem has been that the test over-reacts to Stadis 450, the additive that improves fuel conductivity. In other words, a low MSEP fuel may perform quite adequately in a real coalescing performance test. Considerable pressure from users has influenced great effort to overcome these problems.

Possibly the most important variable that has been investigated has been the replacement of fiberglass with the same coalescing media that is used in manufacturing modern coalescer elements that have passed the tests that are specified in API 1581, Revision 3. The new material looks somewhat like heavy paper; it contains very, very fine glass fibers. Fiberglass insulation is such an inconsistent material that coalescer manufacturers were forced to find better media several years ago. The device that holds the fiberglass pads in the current version of the Micro Separometer is an aluminum capsule called the Alumicel®. So what we are saying is that in the future new Alumicels are expected to contain a paper-like coalescing material instead of fiberglass. Meanwhile, the currently available Alumicels must be considered valid. As of June 1996, encouraging test results show that the instrument itself will probably not have to be revised. This is very good news for owners of the model known as Mark V Deluxe.

This review of tests that attempt to determine the effect of surfactants on jet fuel would not be complete without a comment on the technical property that is involved. That property is "interfacial tension", and in our business it means "strength of the interface between the fuel and water." If the film of molecules at the interface is strong, large water drops can exist. As the interfacial film decreases in strength, the smaller the water drops will be until the mixture of water and fuel becomes an emulsion. The measurement of interface strength is performed in the laboratory by a delicate instrument called a "tensiometer". It is definitely not a field instrument but a kit has recently entered the market that performs this measurement in the field. It is called "SWIFT KIT" and is marketed by Velcon Filters, Inc. This kit is particularly useful in checking the performance of clay treaters that are used in our industry to capture and remove surfactants that cause the interfacial tension to decrease; clay adsorbs the surfactant molecules as described in GamGram No. 14. Therefore, by checking the interfacial tension (IFT) before and after the fuel has passed through the clay, the operator can quickly assess the performance of the clay. This can also be determined with a Micro-Separometer but that is a more time consuming and expensive test.

In conclusion, the Micro-Separometer has proven to be the most reliable instrument for evaluating the ability of a fuel sample to have its water removed by a filter separator. A program is currently underway to improve repeatability, and we will further revise this GamGram to reflect the results of that investigation when it has been completed.