THE GAMGRAM

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This has been a very difficult GamGram to write. It is a very complex subject and opinions vary. We have tried to be objective and fully informative. It is a bit repetitive in places, to be complete. The nature of this subject is complicated, so please read it carefully and completely. There are no simple answers.

We need to cover a little history to start.

Jet fuel filtration in the last 50 years went from Filter Separators (made to API/EI-1581) to Monitors (Made to API/EI1583 - Note, API transferred these standards to EI many years ago).

Filter separators filter out dirt and separate water. They work very, very well. The water collects in the bottom of the filter vessel, the “sump.” They are the mainstay of the industry from the refinery to the airport. Every time fuel moves on its way to the airport, it passes through a filter separator. These work horses have evolved over the past 60-70 years. In high dirt environments, pre-filters are used to remove dirt cost effectively, but are followed by filter separators.

Monitors were discovered to provide final (into plane) filtration that was excellent and at a lower cost. They positively removed the dirt and water we were concerned with. The industry was happy with monitors on into-plane filtration for a long time, but then we found that some of the filter material (SAP) was getting to the aircraft fuel controls, a bad thing. So now we are faced with the need to replace these SAP elements, and still get clean, dry fuel to the aircraft.

More on the available solutions later.

As we have established, filter separators have worked well for decades, with some occasional problems. Since then, this technology has improved quite a bit. SAP elements were considered slightly better at stopping water, were much cheaper and the vessels didn’t have to have a water float or probe to stop flow in the vehicle if water built up in the “sump,” where it collects. They were also smaller and lighter. The benefit was more in cost than quality.

Today (and for some time), filter separator technology is really very, very good. As an example, JFK and Newark International Airports have operated with every into-plane filter separator followed by a monitor for decades - without a single filter separator passing water, not even once.

The New York airports are considered a difficult location because much of the fuel, over the years, has come by multi-product (common carrier) pipeline. Slight mixes with other fuels are inevitable in such systems. This stresses filter separators but modern separators have been able to stand up to these challenges.

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The SAP technology made for less expensive filter elements, stopped the water and fit inside much less expensive (and more importantly much LIGHTER) filter vessels. The smaller size and lighter weight of vessels designed for SAP elements makes replacing them with modern filter separators often impossible. Not only because they are much larger, but (full of fuel) **much** heavier.

So for into-plane filtration of aviation fuels, virtually everyone used monitors. As previously mentioned, the Port Authority chose to keep the filter separators and add monitor vessels downstream of them. At the time it seemed excessive, but obviously it is now seen as a wise decision. As an industry, we have gained from their decision, because we now know for certain that modern filter separators can be trusted, they do not pass dirt or water in the "real world" (assuming the fuel is basically good fuel).

Since it was discovered that some of the water absorbing material (SAP) got down-stream of the old monitors and could cause problems in the aircraft, SAP technology is being removed from the industry standards. You need to change your filtration. The time frame depends on where you are - ask your airline or oil company if in doubt.

WHAT IS THE NEXT STEP?

Ideally, the solution would be to use the same filter vessels as we used with SAP elements - because filter separators are much larger and heavier. So a solution that did not require heavily modifying the vehicle was sought.

AFGUARD

The first approved technology is the Faudi electronic sensor, the "Afguard". This is composed of a control box and a screw-in sensor that mounts to the fuel pipe. It is used with simple dirt-only filter elements. The elements meet EI-1599 and remove only the dirt - so they MUST have an electronic sensor to sense water. The sensor stops flow if water is sensed downstream of the filter vessel. The advantage was that no modification of the vessel was needed. The disadvantages are high initial cost with installation and the simple fact that if water is present, the sensor cannot remove the water. The elements tend to strip water somewhat, but not to the required standards. This approach meets the EI-1598 standard and is fully approved. Shell Oil uses it widely without any significant reported problems.

The advantage of the Afguard is that you only need to modify the pipe and install a control box, you do not need to replace or modify the vessel. But there must be power, it will not work on an unpowered "towable" hydrant cart without power being added.

It is also an expensive system. Reports are that, installed, this can range from (at least) $20,000 to as much as $40,000 USD, plus downtime. (We assume the highest price is for an unpowered hydrant cart). Recalibration periodically (we believe every two years) is a long term cost to also keep in mind.

Velcon has a sensor in development, called the "WIF" or Water In Fuel sensor. At this time we have no news on any testing to EI1598. It is not presently available.

BARRIER ELEMENTS

Velcon has released a new element that fits directly into existing monitor vessels which removes dirt and water, and the water can be drained. These elements do not absorb water as SAP did, the

elements have a media that repels or “blocks” the water, hence the name “barrier” elements. The advantage is that no modification of the vehicle is needed. The disadvantage is that it is a very fine filter. If there is a lot of fine dirt in the fuel, filter element life may be a problem. In addition, the elements are more expensive than the old SAP elements (but not filter separator elements). Barrier elements have met the requirements of EI1588 and CSA B836-22 and are approved by A4A (the US ATA-103 standard).

CONTAINMENT FILTERS

Facet is working on a direct replacement filter that stops and holds water, but has no SAP. It does not absorb water as SAP does, it holds the water, hence the name “containment” filter. So it appears to work like the SAP elements, and has the advantages of SAP, but has no SAP. In addition, the media they use does not (appear to) react to the fuel or additives. This seems to be an ideal solution, but it is not yet approved for use. This is changing and at the time of this writing, approvals are being sought. This may take as long as 1-3 years.

The advantages of barrier (and eventually containment) elements is that no modification to the refueling vehicle needs to be made, and no water goes into the aircraft.

The disadvantage of barrier elements is that they can plug with fine dirt, and they are very fine filters. So replacement cost may be a “barrier” (sorry for the pun).

We don’t know enough about the containment elements at this time, but it seems that they would be a good alternative if they get approved. The elements should have long life and remove virtually all water. Containment appears very promising, but due to the processing of approvals, this may take years.

There have been some reports of the Afguard sensors apparently indicating that water is present when it is not present (perhaps sensing turbulence, air, or vapor bubbles). The policy of the oil company, airline or refueler operator must address how to return to operation if water is indicated. You need to be sure water does not reach the aircraft. Flushing or recirculation can be part of this.

OVERVIEW: WHAT IS YOUR BEST PATH?

The size of your operation makes a difference. There is a great deal of difference between large and small airports. A small airport may only pump 5,000 gallons/13,000 liters a month and a large airport may pump as much as 4 million gallons/15 million liters a day.

Obviously a small filter separator, under 100 GPM/400 lpm, is less expensive than an Afguard. So fuel throughput is a major factor.

Barrier elements in small vessels may be a better choice, depending on how much fine dirt you have. BUT trying barrier elements is a simple thing, and worth considering.

There are also new smaller into-plane filter separators, with 2” coalescer elements, but they are still bigger and heavier than monitor vessels of the same flow rate capacity. (Never forget the weight of the fuel inside!)

Due to the high initial cost, an electronic sensor may be ideal at a large airport and less financially advantageous at a small airport - as opposed to barrier elements (or eventually containment elements) due to the high cost of the Afguard and installation of the sensor and an electrical control box - even if

there is fine dirt that plugs the elements. If a US explosion-proof electrical installation is required, that makes it more expensive.

The costs need to be studied and compared. Also, if there is a problem with a water sensor, someone on the staff needs to be educated on how to troubleshoot the system and deal with alarms.

(If and when containment technology is approved, this would be a simple solution. Containment technology is not expected to be sensitive to fine dirt, as barrier technology is. We have no idea at this time if this is true and what the cost of containment elements will be.)

As the fuel throughput gets larger, the cost of replacing barrier elements due to fine dirt can be greater than the Afguard approach.

But there is the other option: replacing the filter vessel with a filter separator. As mentioned before, this (as well as simply using the barrier elements) is definitely an option to consider in fixed, very low flow rate systems, such as for very small aircraft. It is often not possible on larger refueler vehicles, due to the larger size and weight of filter separators, but it may then make sense to replace the vehicle, depending on the age and cost of maintenance.

Some refueler vehicles may be able to accept a filter separator. This is unlikely, but possible. You may be able to down rate a refueler (for example from 300 gpm/1,100 lpm to 200 gpm/750 lpm) to get a filter separator to fit. But be sure the added weight of the vessel full of fuel can be handled by your vehicle.

But do remember, a filter separator requires a water sensor. This can be a float or a probe, but this adds costs, including installation. But a filter separator does NOT need a high differential pressure (DP) sensor (such as a switch on the Gammon Gauge) and such a switch is (or is likely to be) required with barrier elements - and we assume it will be required with Containment elements, if and when they are approved.

In this paper, we have attempted to be clear, informative and succinct - but not take sides or leave anything important out. There is no simple, ideal solution, at this time. Every path carries an added cost over the old SAP monitor elements.

In our opinion, we feel the long term solution on new refueler vehicles is to go back to filter separators. They tend to provide nearly uninterrupted operation, a great thing! Down time, for whatever reason, is a major headache.

For more information, please contact the filter manufacturers, your oil company, JIG, A4A, or the airline.