SetaAnalytics Technical Applications Note For IP PM DP Test Method for SDA Content of Distillate Products including Jet A-1 & Diesel Fuels

Background and Need

The use of static dissipater additive (SDA) has been used for many years in the aviation industry to ensure that Jet Fuel that is distributed, pumped and transferred to aircraft has minimal opportunity to become charged. If there was no SDA there is a possibility of a static discharge, where just one spark can ignite the fuel and impact surrounding infrastructure such as fuel loading gantries, terminal tanks, or a refuelling hydrant on the airport apron when loading fuel onto a plane.

The SDA material authorised for aviation Jet A-1 use is STADIS 450. This is a long chained hydrocarbon with an anionic polar head group which is normally a sulphonic acid derivative, such as a sulphonate partnered by a cationic metal. The addition and level of dosing SDA into Jet fuels is very closely specified, to ensure that sufficient is added to maintain operability against static effects, but not to high a level that its presence may compromise the quality and combustion performance of the Jet fuel.

The SDA is generally dosed at the refinery release stage, prior to distribution, in most cases the dosage level is accounted for by simple formula of vol/wt % of SDA dosed into the jet fuel using an inline mechanical metering device. The reliability and robustness of this metering technology can sometimes be of concern. The whole premise of accuracy is based on the metering device working correctly as the addition is made. Often, "*under or over*" dosing is a common cause, in situations where the metering device may become unreliable or may in extreme cases totally breakdown and fail allowing either no or too much SDA to be added to the Jet.

Due to surface active nature of the SDA the level of additive in certain conditions of distributions (corroded surfaces), may be initially dosed at the correct level and then drop off significantly, In such cases, on further checking at the airport fuel storage depots, one final dosage may be allowed after approval by the refuelling supplier.

One of the main issues in the past, and still of current concern, is the determination of the conductivity of the jet fuel which is measured, and then equated back to the level of SDA still present in the fuel. The robustness of this simple test is sometimes questionable, since it is not selectively measuring the SDA, but purely the conductivity of the fuel that may be due to other ionic components that are not active SDA, and therefore may not offer any protection against preventing a static discharge.

In the last few years a new HPLC ASTM and IP method has been developed by Air BP and Innospec Inc to measure accurately the SDA content by separating the SDA components chromatographically using HPLC and determining the SDA peak, subsequently the concentration of SDA, to very low ppm levels, covering the range of SDA expected in these distillate fuels.

The Fuels

The fuels that may contain SDA includes; Jet A-1, meeting the MOD DEF STAN 91-91 specification, and Jet A-1 blended fuels released and certified globally outside North America. Also with advent of ultra low sulfur diesel and gas oils, these fuels are more prone to static discharge issues. Therefore, in the distribution and/or supply chain, the use of SDA additives is becoming more common. Especially, as in recent years, there have been fuel related fires at retail petrol stations, at pipeline transfer sites and tanker loading terminals.

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<u>The Separation & Measurement Instrumentation</u>

The HPLC system comprises of 5 critical parts to enable quality values to be obtained;

1. ***Mobile Phase Degasser system***
2. ***Injection Valve***
3. ***Separation Column***
4. ***UV Detector***
5. ***Integrator***

1. Degasser System

The mobile phase degasser is a very useful tool to ensure the mobile phase system is free of any dissolved air, which can lead to operability problems when the mobile phase pumped on pressure through the pre-packed column system. This can lead to poor separation and may also affect the detection of the aromatic components.

2. Injection Valve

This highly engineered unit allows via the sample loop the delivery and insertion of the sample dissolved in a diluent, to be carried on down into the separation column as one discrete aliquot.

3. Separation Column

This is the most crucial part of the separation system, and the quality of the absorbent material, in terms of chemical derivatisation, particle size and distribution have a major impact on the separation efficiency, the component resolution and the repeatability of the separation. As well as the reproducibility of the column performance for inter lab comparisons. Besides these critical areas, the longevity of the column is also determined by the quality of the packing material and the mechanical functionality of the columns construction.

4. UV Detector

The sensitivity and base line stability of both the measurement source and the detector are very important to ensure good repeatable measurements at the lower levels that are to be determined.

5. Integrator

This is the final component of the system that enables the analyst to use either automatic or manual chromatographic determinations of the component peaks are they exit the column and are detected via the Refractive Index measurement. Not only does this system if set up correctly allow effective, repeatable measurements to be made, but will all automatic concentrations to be determined, if programmed with a suitable calibration data set for the components under evaluation. Also the system will provide an archiving capability to allow traceability, plus can be connected to a Laboratory Information Management System (LIMS).

An Example of typical separation is shown in the following example for a Jet A-1 fuel meeting the DEF STAN 91-91 Jet A-1 specification.