Evaluation Protocol for Corrosion Inhibitors for Fuel Ethanol

For more than 20 years, the Renewable Fuels Association (RFA) has recommended that fuel ethanol producers and importers add a corrosion inhibitor to fuel ethanol. The corrosion inhibitor should be included at a treat rate sufficient to provide corrosion protection comparable to that of other available motor fuels while protecting the transportation distribution system from corrosion concerns. RFA has transitioned the recommendation from a general guideline format to an evaluation protocol.

This RFA Evaluation Protocol for Corrosion Inhibitors provides an evaluation technique for ethanol manufacturers to determine the appropriate level of corrosion protection for the fuel produced. This protocol may be used with denatured or undenatured ethanol intended for use as a spark ignition engine fuel. The RFA recommends that the tests discussed below be considered by each manufacturing location to confirm the effectiveness of the candidate fuel corrosion additive. Corrosion concerns are expected to vary from fuel to fuel as no two ethanol production plants or processes are identical.

Corrosion inhibitors may also assist in altering pHe levels of fuel ethanol. Ultimately, it is the responsibility of the ethanol manufacturer to address the fuel's corrosion potential.

Evaluation of Fuel Ethanol as an Unleaded Gasoline Additive

For evaluation of fuel ethanol intended for E10 (10% Denatured Fuel Ethanol/ 90% Unleaded Gasoline) or desired fuel blend ratio, the following protocol is suggested:

- • Secure the motor fuels for the evaluation

- ✓ Unleaded gasoline *without additives* that meets the requirements of ASTM D4814 Standard Specification for Automotive Spark-Ignition Engine Fuel with the exception of exhibiting a "C" rating by the NACE Standard Test Method TM0172-2001 should be used as the gasoline blendstock. Confirmation of the gasoline characteristics should be provided.

- ✓ Fuel ethanol, either denatured or undenatured, that represents typical production from the ethanol manufacturing plant process also meeting ASTM D4806 Standard Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark- Ignition Engine Fuel should be used as the fuel ethanol blendstock. Confirmation of the fuel ethanol characteristics should be provided.

- Blend the desired gasoline/ ethanol fuel ratio, in this case 10% fuel ethanol and 90% unleaded gasoline, with the candidate corrosion inhibitor utilizing the recommended treat rate. Determine the corrosion rating with test method NACE TM0172-2001. The fuel blend with candidate corrosion inhibitor must meet a NACE Standard Test rating of B+ (less than 5% surface rust) or better for the recommended treat rate to be acceptable.

  - ✓ The corrosion inhibitor supplier should clearly state the acceptable treat rate, including a maximum inclusion level.

- Determine the corrosion rating using NACE TM0172-2001 of the same desired gasoline/ ethanol fuel ratio blend after 120 days of storage to emulate expected shelf life. The fuel blend with candidate corrosion inhibitor must again meet a NACE Standard Test rating of B+ (less than 5% surface rust) or better for the recommended treat rate after 120 days of storage to be acceptable. Sample should be stored under laboratory ambient conditions, in a non-metal container, protected from UV light and following all safety precautions.

- An optional analysis may be performed to confirm the effective treat rate for the candidate corrosion inhibitor and gasoline/ ethanol fuel blend. Utilizing the desired blend ratio determine the NACE Standard test rating at 75% of the recommended fuel additive treat rate. The fuel blend with 75% treat rate of corrosion inhibitor should not reach the B+ NACE Standard Test rating for the recommended treat rate after 120 days of storage.

Evaluation Specific to Fuel Ethanol

Evaluation specific to the fuel ethanol may also be necessary.

- Determine the buffering capacity of the corrosion inhibitor using ASTM D6423 Standard Test Method for Determination of pHe of Ethanol, Denatured Fuel Ethanol and Fuel Ethanol. To determine that the corrosion inhibitor has adequate pHe buffering capability to meet the pHe requirements of the most current version or the ASTM D 4806 Standard Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel specification, analyze fuel ethanol before and after treatment with the candidate corrosion inhibitor.

  - ✓ Fuel ethanol should also meet the ASTM D4806 pHe requirements after 120 days storage to emulate expected shelf life. Sample should be stored under laboratory ambient conditions, in a non-metal container, protected from UV light and following all safety precautions.

- Secure a statement of solubility from the corrosion inhibitor supplier demonstrating the fuel ethanol/ gasoline blends and treat rate tested are completely soluble. RFA recommends the Modified MOBIL Filterability Test, or an equivalent test correlating to real world data, for this evaluation. The Filterability Test can be provided upon request.

- Secure a statement of "no harm" from the corrosion inhibitor supplier.

Corrosion inhibitor suppliers should provide the treatment guidelines including recommendations for storage, handling and effective treatment rates information. Additionally, the fuel additive supporting information should include precautions, suggestions, limits, calculation tools, cost estimates and/ or a recommendation for verification of consistent fuel additive addition. Safety information such as a Safety Data Sheet (SDS) should also be available.

Additional Considerations

In the past, fuel additive chemistries have been identified that have proven to be <u>insoluble</u> in high concentrations of fuel ethanol, such as poly isobutylene amine (PIBA). It is critical that fuel producers are aware of all fuel additives that are present, whether intentionally added by the fuel ethanol, denaturant or gasoline producer or seller, or by the logistic systems transporting these fuels.

If you should have any questions or would like to comment on this issue, please don't hesitate to contact us.

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