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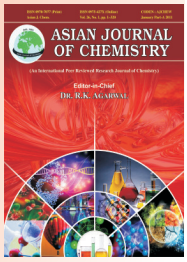

Automotive High Clean Fuel Corrosion Research

GUANGJUN YANG* and XU LUO

Zhengzhou Institute of Aeronautical Industry Management, Henan 450015, P.R. China

*Corresponding author: E-mail: snower@zzia.edu.cn

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The high clean fuel is a mixture of 60 % of methanol and 40 % of the modifier, the modifier is a mixture of oleic acid, petroleum ether and other petrochemical products. Experiment with different proportions of clean fuel and petrol mixture was performed for the electric fuel pump into the corrosion test. The results show that the mixture without adding antioxidants, copper corrosion is quite dramatic. Gradually increase the amount of antioxidant, make it meet the eligibility criteria. Among them, when the antioxidant content of No. 1 mixed liquor is 90 ppm, it meet the test standard ealier; when the antioxidant content of No. 2 mixed liquor is 150 ppm, all the additives except No. 2 additive meet the test standard. When the antioxidant content of No. 3 mixed liquor is as high as 200 ppm, it will meet the test standard. The result of present experiment shows that there is no mercaptan in the mixed liquor of test.

Keywords: Clean fuel, Gas, Corrosive, Antioxidants.

INTRODUCTION

Chinese energy problem has become the main bottleneck of sustainable development, it also affect the national energy strategy security directly[1]. The national development and reform commission issued long-term energy saving special planning, determined for the ten major energy conservation projects, one of which is saving and replacing oil project, developing of alcohol ether fuel, promoting high methanol gasoline. The most qualified one to replace oil products is methanol gasoline in China, but some problems about high methanol gasoline need to solve[2], the outstanding problem is mainly displayed on the corrosion problem of electric fuel pump made by methanol gasoline.

Corrosion of methanol on the fuel pump belongs to wet corrosion in the corrosive environment[3], although it is wet corrosion, but the water is very few, so it is not strict wet corrosion. It is not very good to classify it into the corrosion of anhydrous organic solution, because some gasoline in it. This kind of corrosive medium can be regarded approximately as non electrolytic medium. In this type of reaction, water is the role of a corrosion inhibitor. But in this kind of organic liquid corrosion, mostly because of the existence of the trace water, so the corrosion in organic liquid belongs to electrochemical corrosion or overall corrosion.

This research adopts the high clean fuel is a mixed liquor of 60 % of methanol and 40 % of modifier, the modifier is mixed by oleic acid, petroleum ether and other petrochemical products, this product is made by Xi 'an aerospace power technology research institute, Henan space force in new energy Co. Ltd., Zhengzhou aeronautic industry management institute in joint research, compared with the conventional methanol gasoline. The product can be freely mixed with gasoline in any proportion, even without adding any gasoline can be used on gasoline engine completely, to entirely replace the distinctive features of gasoline. This experiment using the different proportion of clean fuel and gasoline as mixed liquor to make the contrast experiment of corrosion effect of electric fuel pump, respectively and according to the results to determine the suitable proportion of good corrosion performance of clean fuel resistant antioxidant.

EXPERIMENTAL

In present work, the colourimetric tube, electrothermal constant temperature oven, constant temperature water tank, sheet copper, shade guide, sample polishing machine and abrasive paper are used.

Methanol (pure chemicals), sulfur powder (sublimation, dry), lead acetate (analysis), sodium hydroxide (analysis), cadmium chloride (analysis), hydrochloric acid (analysis), potassium iodide (analysis), acetic acid (analysis), starch (analysis), distilled water, toluidine (pure chemicals), isopropyl alcohol (pure chemicals), isoamyl alcohol (pure chemicals),

cyclohexanol (pure chemicals), composition of oil, oil samples, light naphtha, heavy aromatics gasoline, acetone (pure chemicals), styrene acrylic three azole nitrogen (pure chemicals).

Experimental steps

Sheet copper: This experiment choose red copper as specimen, firstly, polished the specimen with No. 150 abrasive paper, secondly, polished carefully with No. 180 abrasive paper and then use anhydrous ethanol and ether to wash it, finally dry and weight.

Preparation of mixed liquor of experiment: Firstly, according to certain proportion, mixing clean fuels with gasoline, the experimental mixture are shown in Table-1.

TABLE-1
SEVERAL KINDS OF METHANOL GASOLINE COMPONENTS

Mixture	Components	
	Clean fuel	Petrol
No. 1	5	95
No. 2	50.0	50.0
No. 3	100.0	0

Corrosion solution: The addition of clean fuels will bring in water and acid to enhance the corrosivity of the fuel. In this experiment, adding certain amount of water and clean fuel into gasoline as corrosion solution.

Test on copper corrosion: Soaking clean copper into the test tube which filled with gasoline, using a cork plug tube with holes and then put it into the constant temperature water tank of 50 ºC. After 3 h, take out the copper, remove the oil, compare the copper corrosion to standard colour plate, the results are shown in Table-2.

TABLE-2
COPPER COMPARE RESULTS

Hierarchical name	Color
Level 1 Mild discoloration	Orange
Level 2 Moderate discoloration	Light colour or golden
Level 3 Severe discoloration	Broken colour
Level 4 corrosion	Deep color or black

Aromatic hydrocarbons and light petroleum products qualitative test by mercaptan (Dr test method): The first step, preparation of the lead acid sodium solution. Dissolved 25 g lead acetate in 200 mL distilled water and filter it into 100 mL solution which dissolved 25 g sodium hydroxide and then heated in boiling water for 0.5 h, after cooling, diluted it with distilled water to 1 L. Storing this solution in an airtight container.

The second step, pouring 10 mL sample oil and 5 mL sodium plumbite solution into a measuring cylinder with a lid, shook 15 s and then add a small amount of sublimation sulfur powder (the quantity just equal to the mixed liquor), shake again for 15 s, let it stand still for 1 min, observing the colour of sulphur powder in the measuring cylinder. If colour is kept constant or lighter, which means mercaptan in sample oil do not exceed limit; If sulfur powder become to brown or black, which means sample mercaptan exceed limit.

RESULTS AND DISCUSSION

In the 4 kinds of No. 1 mixed liquor, when without adding antioxidants, copper corrosion is quite dramatic. Gradually increasing the amount of antioxidants and level of corrosion down form 4 a to 1 a, finally to qualified corrosion level. In which, No. 3 additives reach the test standard earlier when the antioxidant content is 90 ppm (Table-3).

TABLE-3
No. 1 MIXED LIQUOR CORROSION LEVEL

Sample oil additives	Antioxidant (ppm)					
	50	60	70	80	90	100
1	4a	2e	2a	1b	1b	1a
2	4a	2e	1b	1b	1b	1a
3	4a	2a	1b	1b	1a	1a
4	4a	2e	2a	1b	1b	1a

TABLE-4
No. 2 MIXED LIQUOR CORROSION LEVEL

Sample oil additives	Antioxidants (ppm)					
	70	90	110	130	150	170
1	4b	2e	1b	1b	1a	1a
2	4b	2e	1b	1b	1b	1a
3	4b	2e	1b	1b	1a	1a
4	4a	2e	1b	1b	1a	1a

In the 4 kinds of No. 2 mixed liquor, when without adding antioxidants, copper corrosion level is higher. Gradually increasing the amount of antioxidant, corrosion level eventually reduced to 1 a, the corrosion level is qualified now. In the antioxidant content of 150 ppm, excepts 2 additives, the rest of the additives meet the test standard.

In the 4 kinds of No. 3 mixed liquor, the level of copper corrosion is higher than the No. 1 and No. 2 oil samples. Gradually increasing the amount of antioxidant, corrosion level eventually reduced to 1 a, corrosion level is qualified. At this moment, the antioxidant content is up to 200 ppm (Table-5).

TABLE-5
No. 3 MIXED LIQUOR CORROSION LEVEL

Sample oil additives	Antioxidants (ppm)					
	150	160	170	180	190	200
1	4b	2e	2e	1b	1b	1a
2	4b	2e	2e	1b	1b	1a
3	3b	1b	1b	1b	1b	1a
4	3b	1b	1b	1b	1a	1a

Dr test results: Regulation in China, from 1st January, 2003 on, the implementation of mass fraction of sulfur is no greater than 0.08 %[4]. I in nationwide. The experimental results are shown in Table-6, it can be seen that the colour of sulphur powder on the interface is invariant or lighter than orange, thus concludes that the mercaptan content in the sample do not exceed standard.

Conclusion

When No. 1 mixed liquor without adding antioxidants, copper corrosion is quite dramatic. Gradually increasing the amount of antioxidants, when antioxidant content is 90 ppm,

TABLE-6
COMPARING TEST RESULTS SAMPLE OIL CONTAINING DIFFERENT MODIFIER MERCAPTAN

Sample oil	1	2	3	4
Interface on sulphur powder mercaptan	Same colour qualified	Same colour qualified	Same colour qualified	Color becomes shallow qualified

No. 3 additives reach the standard test earlier. When No. 2 mixed liquor without adding antioxidants, copper corrosion level is higher. Gradually increasing the amount of antioxidants and when the antioxidant content is 150 ppm, excepts 2 additives, the rest additives are reaching test standards. The level of corrosion of No. 3 mixed liquor higher than No. 1 and No. 2. Gradually increasing the amount of antioxidant, corrosion level qualified in the end. At this point, the antioxidant content is up to 200 ppm. The Dr. experimental results shows that the experiment mixed liquor does not contain mercaptan.

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