

Activities for Bio Fuels in Japan

Indo-JARI Round Table 2008

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Shogo SAEGUSA

Fuels and Lubricants Committee

Japan Automobile Manufacturers Association

Outline

1. Introduction

2. Study of Bio Ethanol Fuel Specification

3. Study of Bio Diesel Fuel Specification

4. Conclusion

JAMA Position about Biofuels

- **From the view point of energy security and CO2 reduction, biofuels become more important.**
- **JAMA positively corresponds to the introduction of the biofuels.**
- **There are issues to be solved.**
 - **Good fuel quality at the pump to prevent problems**
 - **Competition with food**
 - **Cost, etc.**

Conformity Test for Ethanol Blended Gasoline

In Japan, ethanol blended gasoline is not introduced to the market and vehicles in the market are not applicable for these fuels. Therefore, conformity tests were conducted for vehicles that has already been used in the market.

Conformity Tests (Key Issue)

Safety

Materials Compatibility

Metal Corrosion,
Degradation of Rubbers and Plastics

Environment

Effect for Emission

Exhaust Emissions, Evaporative Emissions
(Increase of Vapor Pressure)

Performance

Effect for Performance

Driveability, Fuel Economy

Effect of Ethanol on Metals / Dry Corrosion

Corrosion on aluminum material were found at more than 5% of ethanol content.

As for other metals such as zinc, any significant effect was not found.

Immersion Test Results

(Test condition : 100 deg.C x 720 Hr)

Fuel condition	Test piece condition		Immersion condition	Ethanol content					
				0%	1%	3%	5%	7%	10%
Virgin	Single-material	A1050	in liquid	OK	OK	OK	27.8	59.7	100
		A6061	in liquid	OK	OK	OK	8.6	5.8	18.1
		ADC12	in liquid	OK	OK	OK	41.4	39.2	27.3
	Bimetallic	Zn/A1050	in liquid	OK/OK	OK/OK	OK/OK	OK/34.2	OK/65.4	OK/100
		Zn/A6061	in liquid	OK/OK	OK/OK	OK/OK	OK/8.6	OK/6.8	OK/13.0
		Zn/ADC12	in liquid	OK/OK	OK/OK	OK/OK	OK/34.8	OK/30.7	OK/30.9

The number in the table is a ratio of the mass decrease before it immersion (%)

OK : No change

* : Change in Surface without Reduction in Mass

** : Reduction in Mass

*** : Completely Dissolution

Specification of Ethanol Blended Gasoline in Japan

Item	Legal Standard	Industrial Standard
Lead	ND	←
Sulfur Content	10ppm Max (After 2008)	←
MTBE	7vol% Max	←
Benzene	1 vol% Max	←
Heating Oil Content	4vol% Max	←
Methanol	ND	←
Existent Gum	5mg/100ml Max	←
Ethanol	3vol% Max*	←
Oxygen Content	1.3wt% Max*	←
RON	/	ex) 89 Min (regular)
Density		0.783 g/cm ³ Max (15°C)
Distillation Properties		ex)T50 75°C Min;110°C Max
RVP		44-78kPa
Corrosiveness to Cupper		1 Max
Oxidation Stability		240min Min

*)These were decided taking into account the conformity with in-use vehicles.

Conformity Test for FAME Blended Diesel Fuel

Conformity tests were conducted for vehicles that has been already used in Japanese market.

Evaluation was conducted with the fuels based on EN14214 and blended FAME up to B5

Conformity Tests (Key Issue)

Safety

Materials Compatibility

Metal Corrosion, (Oxidation Stability)
Degradation of Rubbers and Plastics

Fuel System Durability

Wear in Injector (Sludge Formation)

Environment

Effect for Emission

Exhaust Emissions

Performance

Effect for Performance

Cold Startability

Summary of Conformity Tests

Test Items	Results	Summary	
Material Compatibility			
Metals	Fail	Corrosion in Tern Sheet	
Rubber & Plastics	Pass	No effects of Ester as far as less than 5v%	
Cold Performance	—	Poor Startability	
Long Storage Test	Pass	Slight Degradation	
Fuel Line Parts Test	Fuel Filter Test	Pass	Same as diesel fuel with B5
	Fuel Tank Test	Fail	Corrosion and melting plating in lead-tin alloy coated and electrolytic zinc-coated steel sheets
	Fuel Pipe Test	Pass	Same as diesel fuel with B5
	Fuel Hose Test	Pass	Same as diesel fuel with B5
FIE Durability Test	-	Wears in injector were found in some cases. However, it was not confirmed if wear was caused by FAME.	
Engine Durability Test			
LD, ID&DI	Pass	Observation of no trouble with B5	
HD, DI	Fail	Flow loss and Wear in Injectors with B5	
Vehicle Durability Test (LDV, IDI)	Pass	Observation of no trouble with B5	
Emission Test	Pass	Little Impact with up to 10v%	

Note) Test FAME consists of PME:RME:SME=60:38:2 and is blended in commercial diesel fuel by 5%.

Effect of Improved Oxidation Stability on Fuel Tank Corrosion

Test Fuel:

Commercial diesel fuel blended with the FAME meeting EN14214 by 5vol%

Oxy. Stab
of B100
: **6 Hrs**



Test Fuel: Same FAME as above with 400ppm of anti-oxidant (20ppm as B5)

Oxy. Stab
of B100
: **10 Hrs**



Japan's B5 Specification

Items	Level
Sulfur	10 ppm max
Cetane Index	45 min
T90	360 deg.C max
FAME content	5 mass% max
Methanol	0.01 mass% max
Triglyceride	0.01 mass% max
TAN	0.13 mgKOH/g max
Individual Organic Acid	30 ppm max
Oxi. Stability (Acid)	0.12 mgKOH/g max

FAME related Properties

Monitor for refining level of FAME.
If FAME meets JASO M360/EN14214,
B5 will meet these requirements.
Triglyceride is also a monitor for
blending crude oil and/or cooking oil.

This level of oxidation stability is
essential to prevent metal corrosion.
Even though FAME has 6 Hrs of
oxidation stability, B5 will not be able
to meet this requirement.

Specification of FAME in Japan

Items		Specification	
		Limit	Test method
Ester content	mass%	96.5 min	EN 14103
Density	g/ml	0.86 - 0.90	JIS K 2249
Kinematic Viscosity	mm ² /s	3.5 - 5.0	JIS K 2283
Flash Point	Deg.C	120 min	JIS K 2265
Sulfur	ppm	10 max	JIS K 2541-1, -2, -6 or-7
10% Carbon Residue	mass%	0.3 max	JIS K 2270
Cetane Index		51 min	JIS K 2280
Sulfated Ash	mass%	0.02 max	JIS K 2272
Water	ppm	500 max	JIS K 2275
Total contamination	ppm	24 max	EN 12662
Copper Corrosion		1 max	JIS K 2513
Acid value	mgKOH/g	0.5 max	JIS K 2501, JIS K0070
Oxidation Stability		←	
Iodine Number	gl/100g	120 max	JIS K 0070
Linolenic acid methyl ester	mass%	12.0 max	EN 14103
Methanol	mass%	0.20 max	JIS K 2536, EN14110
Mono glyceride	mass%	0.80 max	EN 14105
Di glyceride	mass%	0.20 max	EN 14105
Tri glyceride	mass%	0.20 max	EN 14105
Free glycerine	mass%	0.02max	EN 14105, EN14106
Total glycerine	mass%	0.25 max	EN 14105
Metals (Na + K)	ppm	5max	EN 14108, EN 14109
Metals (Ca + Mg)	ppm	5 max	prEN 14538
Phosphorus	ppm	10 max	EN 14107
Pour point	Deg.C	Meet diesel fuel specification	
CFPP	Deg.C		

- Voluntary specification as JIS K2390
- Almost same as EN14214 except for oxidation stability and cold performance.

When B100 spec. is adopted,

10 Hrs minimum

of Oxidation Stability is necessary for preventing corrosion in fuel line of vehicle.

E100 & B100 Guidelines for E10 & B5 Blends

ACEA, AAM and JAMA issues WWFC which is aiming to realize cleaner fuels for environment and to fulfill customer requirement.

Recently E100 and B100 guidelines for E10 and B5 blends will be published taking consideration of the results of the activities in Japan.

E100 Guidelines

PROPOSED
First edition

WORLDWIDE FUEL CHARTER

JULY 2008
COMMENTS DUE: OCTOBER 1, 2008

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Remaining Issues

- **Sludge formation tendency**
 - **No adequate test method for sludge formation**
⇒ **iodine number & poly-unsaturated FAME**
 - **Relation to oxidation stability besides influence on corrosion is under investigation in Japan**
- **Impact on advanced engine & emission control system (fuel injector, catalyst - - -)**
 - **Severe control of metals content is essential**
⇒ **incl. ash / sulfated ash & phosphorous**
- **Filter plugging issue**
 - **Lower mono-glyceride content limit is under discussion in Europe**

Status of Guideline Finalization

- Draft for comments issued in July, 2008
 - Posted at committee member websites
- Submission: deadline, October 1, 2008
 - Comments by total 15 parties from US, Europe & Asia
- WWFC Committee held on November 7, 2008 (@Chicago) to review comments
 - Feedback document is now under preparation
- Finalization: target, by January, 2009

Conclusion

- Specifications of biofuels blended with conventional fuels in Japan were decided based on technical studies conducted by METI cooperated with industries and institutions aiming to clarify the conformity with existing vehicles in the market.
- It was confirmed that ethanol blending to gasoline fuel up to 3% is applicable for existing vehicles. But it should be noted that review of fuel specifications and good housekeeping are necessary to prevent the deterioration of air quality and market problem.

Conclusion

- Based on the results of conformity tests, it was confirmed that FAME blending to diesel fuel up to 5% can be applied to the vehicles in Japanese market.
- The specifications of EN14214 are almost enough for B100 except the following.
- Oxidation stability requirement in EN14214, that is 6 hrs minimum with Rancimat method, is not enough for preventing metal corrosion.
- If the regulation of B5 specification can be set, it would be desirable to adopt Japanese B5 specification. If not, specifications for B100 should include oxidation stability specification which is not less than 10 hrs.
- This requirement was involved into WWF B100 specification .
- It is recommended to add oxidation stability enhancing additives such as butylated hydroxyl-toluene (BHT) for improving oxidation stability.

Thank you for your attention.