

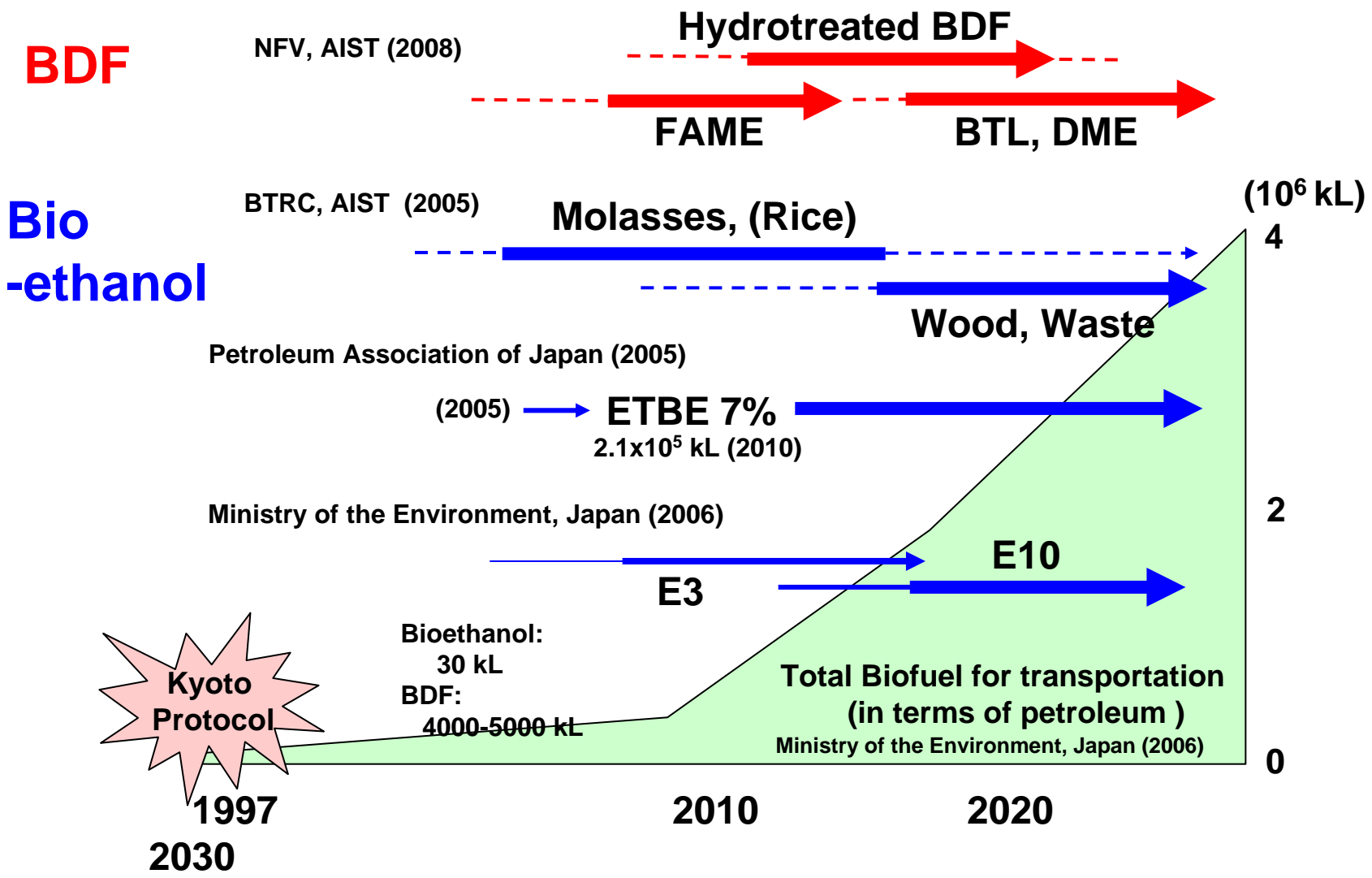
Prospects of Biofuels in Japan, and Preliminary Studies on Biofuel CRMs by the National Metrology Institute of Japan (NMIJ)

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Prospect of Biofuels in Japan



Biofuel Issues in Japan



Various raw materials



Waste cooking (Tempura) oil is the main source of FAME in Japan



Humid climate

→ Increasing moisture in FAME, ethanol

Ethanol vs. ETBE



Ministry of the Environment

→ Ethanol (high vapor pressure, hygroscopicity, corrosion)

Petroleum companies

→ ETBE (environmental risk?)



No FFV

(Flexible Fuel Vehicle)

→ Low upper limit of Biofuel blending rate



No biofuel CRM

→ Low quality analytical data

Quality control is not prescribed in the biofuel standards → Are CRMs (and [SI] traceability) required by testing labs?

Standardization of Biofuels in Japan

Automotive fuels-Fatty acid methyl ester (**FAME**) as blend stock, **JIS K 2390:2008** (Modified EN 14214)

Automotive fuels-**Ethanol** as blend stock, **JASO M 361:2006** (Modified ASTM 4806-04a and ANP n°2)

→ Considered to become JIS

Japanese mandatory law for quality assurance of gasoline and diesel (Amendment, 2007 [for **E3** and **B5**]; Enforcement, from Feb. 2009)

JIS: Japanese Industrial Standards

JASO: Japanese Automotive Standards Organization

Standards for FAME (1)

(for Blending with Diesel Fuel)

Item	Japan (JIS K 2390)		EU (EN 14214)	USA (ASTM D6751-07a)
	Test method	Level		
Ester content	EN 14103	≥ 96.5 mass%	≥ 96.5 mass%	---
Density	JIS K 2249	0.86 - 0.90 g/mL	0.86 - 0.90 g/mL	---
Kinematic Viscosity	JIS K 2283	3.5 - 5.0 mm ² /s	3.5 - 5.0 mm ² /s	1.9 - 6.0 mm ² /s
Flash Point	JIS K 2265	≥ 120 °C	≥ 120 °C	≥ 130 °C
Sulfur	JIS K 2541-1/2/6/7	≤ 10 mg/kg	≤ 10 mg/kg	≤ 15 mg/kg
10% Carbon Residue	JIS K 2270	≤ 0.3 mass%	≤ 0.3 mass%	
Cetane number	JIS K 2280	≥ 51	≥ 51	≥ 47
Sulfated Ash	JIS K 2272	≤ 0.02 mass%	≤ 0.02 mass%	≤ 0.02 mass%
Water	JIS K 2275	≤ 500 mg/kg	≤ 500 mg/kg	≤ 500 mg/kg
Total contamination	EN 12662	≤ 24 mg/kg	≤ 24 mg/kg	---
Copper Corrosion	JIS K 2513	≤ 1	≤ 1	≤ 3
Total acid number	JIS K 2501, K 0070	≤ 0.5 mg KOH/g	≤ 0.5 mg KOH/g	≤ 0.8 mg KOH/g
Pour point	---	(After blending)	---	---
CFPP	---	(After blending)	≤ -15 to $\leq +5$ °C	---

Single chemical species, Chemical group, Indirect index, Physical/Fuel property

Standards for FAME (2)

(for Blending with Diesel Fuel)

Item	Japan (JIS K 2390)		EU (EN 14214)	USA (ASTM D6751-07a)
	Test method	Level		
Oxidation Stability	---	(After blending)	≥ 6 h	≥ 3 h
Iodine Number	JIS K 0070	≤ 120 gI/100g	≤ 120 gI/100g	---
Methyl linolenate	EN 14103	≤ 12.0 mass%	≤ 12.0 mass%	---
Methanol	JIS K 2536, EN14110	≤ 0.20 mass%	≤ 0.20 mass%	≤ 0.20 mass%
Monoglyceride	EN 14105	≤ 0.80 mass%	≤ 0.80 mass%	---
Diglyceride	EN 14105	≤ 0.20 mass%	≤ 0.20 mass%	---
Triglyceride	EN 14105	≤ 0.20 mass%	≤ 0.20 mass%	---
Free glycerol	EN 14105,14106	≤ 0.02 mass%	≤ 0.02 mass%	≤ 0.02 mass%
Total glycerol	EN 14105	≤ 0.25 mass%	≤ 0.25 mass%	≤ 0.24 mass%
Metals (Na+K)	EN 14108,14109	≤ 5 mg/kg	≤ 5 mg/kg	≤ 5 mg/kg
Metals (Ca+Mg)	EN 14538	≤ 5 mg/kg	≤ 5 mg/kg	≤ 5 mg/kg
Phosphorous	EN 14107	≤ 10 mg/kg	≤ 10 mg/kg	≤ 10 mg/kg

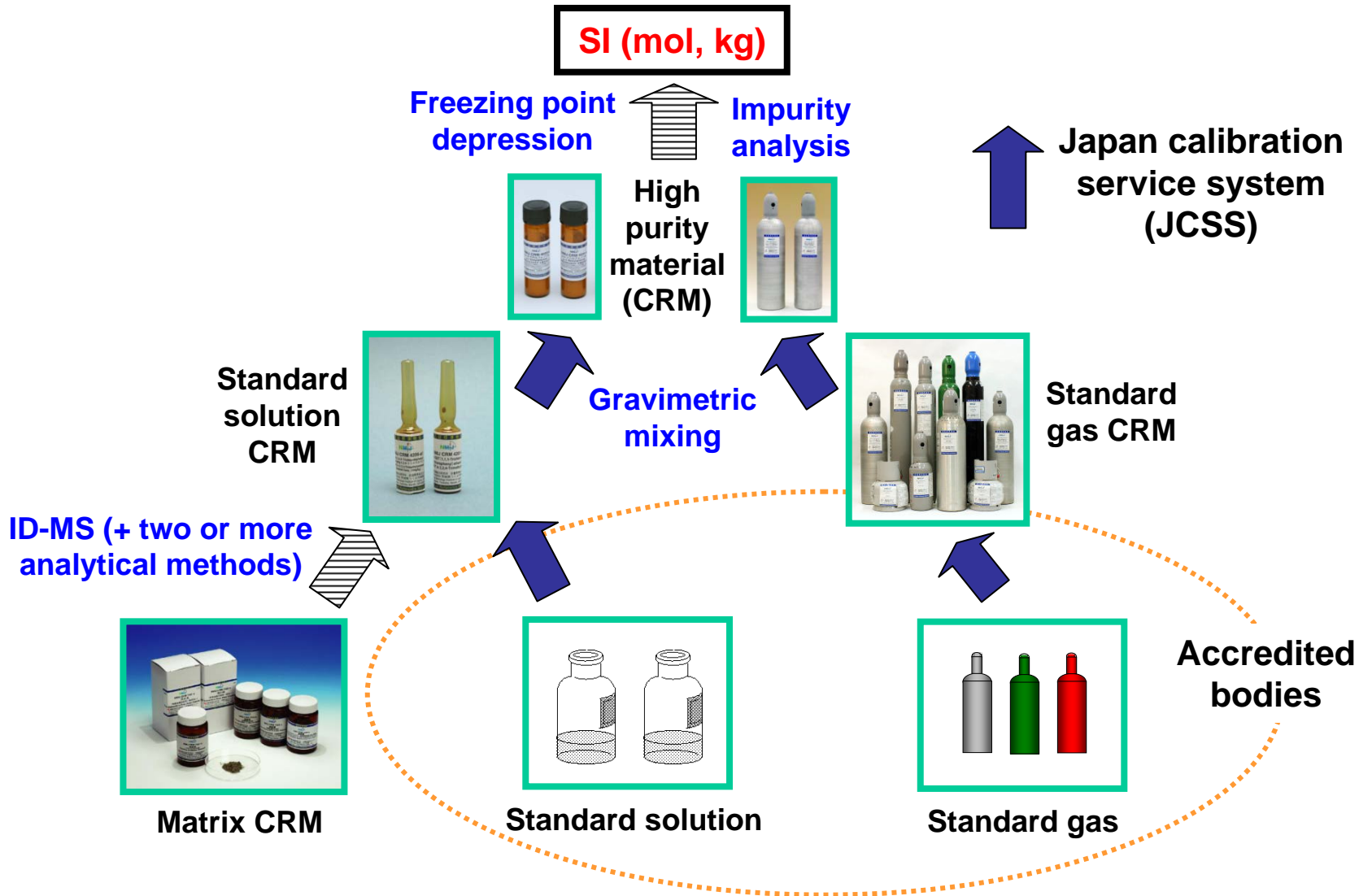
Single chemical species, Chemical group, Indirect index

Standards for Bio-ethanol (for Blending with Gasoline)

Item	Japan (JASO M 361)		Brazil (Portaria ANP n° 2)	USA (ASTM D4806-04a)
	Test method	Limit	Anhydrous (with water)	Denatured
Appearance	(Naked eye)	Transparent, No-turbidity	Transparent, No-turbidity	Transparent, No-turbidity
Alcohol	JAAS001, 6.2	≥ 99.5 vol%	≥ 99.3 (92.6-93.8) mass %	---
Ethanol	---	---	≥ 99.3 (92.6) vol%	≥ 92.1 vol%
Methanol	JAAS001, 6.4	≤ 4.0 g/L	---	≤ 0.5 vol%
Water	JIS K 8101	≤ 0.70 mass%	---	≤ 1 vol%
Organic impurity (except Methanol)	JAAS001, 6.4	≤ 10 g/L	---	---
Electric conductivity	JIS K 0130	≤ 500 μ S/m	≤ 500 μ S/m	---
Evaporated residue	JAAS 001, 6.3	≤ 5.0 mg/100mL	(≤ 5 mg/100mL)	---
Copper	JIS K 0101, 51.2/3	≤ 0.10 mg/kg	≤ 0.07 mg/kg	≤ 0.1 mg/kg
Acidity (As acetic acid)	ISO 1388/2	≤ 0.0070 mass%	≤ 30 mg/L	≤ 0.007 mass%
pH	ASTM D 6423	7.0 \pm 1.0 (pHe)	(6.0 - 8.0)	6.5 - 9.0 (pHe)
Sulfur	JIS K 2541-6/7	≤ 10 mg/kg	≤ 4 mg/kg (sulfate)	≤ 30 mg/kg

Single chemical species, Indirect index, Physical property

NMIJ CRMs and Calibration System



Biofuel CRM development (plan) by NMIJ

Pure material, standard solution CRMs

Pure Ethanol: Supplied as NMIJ CRM 4001-a

Standard solutions of element: Supplied for the JCSS

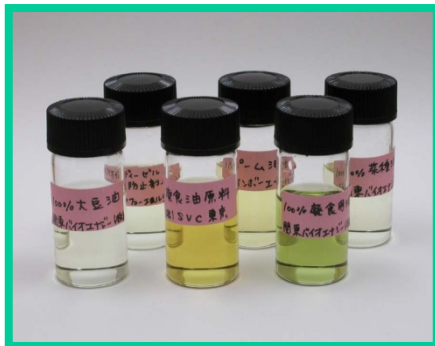
Pure ETBE, Methanol: Considered as NMIJ CRMs

Sulfur in toluene: Supplied as NMIJ CRM 4215-a

Pure FAMES (or std. solution): Not yet considered



NMIJ CRM
4001-a



BDF samples (FAME)

Matrix CRMs

(Bio-)Ethanol: Considered as a CRM candidate

BDF (FAME): Considered as a CRM candidate

(Preliminary investigations on actual samples, left)

FAME/ethanol blended fuel: Not yet considered

NMIJ Matrix Biofuel CRMs



(Bio-)Ethanol → Issue: 2010?

Concentration: regulation levels or 1/10 of them

Certified values: Elements (Cu,S), Methanol,

Water, Ethanol? (SI-traceable)

(Information values: Alcohol content,

other items [obtained by official methods]?)



BDF (FAME) → Issue: 2011?

Concentration: regulation levels or 1/10 of them

Certified values: Elements (Na,K,Mg,Ca,P,S)

Water, Methanol (SI-traceable)

(Information values: FAMES, Glycerides,

other items [obtained by official methods]?)

Research for Physical Standards in NMIJ

Fluid Flow Division

NEDO project (“Leading research for Biomass energy” 2008-2010)



Material Properties and

Metrological Statistics Division

Density, viscosity and other thermal properties

→ Preliminary study