



The Importance of Measurement & Standard for High Quality Biofuel

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Background: National Policy

- National Energy Policy (Presidential Decree Nr. 5/2006): Existing roadmap of Indonesian Biofuel and Energi Mix
- Regulation No. 32/2008 from the Minister of Energy and Mineral Resources
- Standard of biofuel (biodiesel and bioethanol) is already available

But unfortunately so far:

- No reference material available in Indonesia (reference biodiesel or bioethanol) for measurement and controlling the implementation of the program as well as for the industry & trading

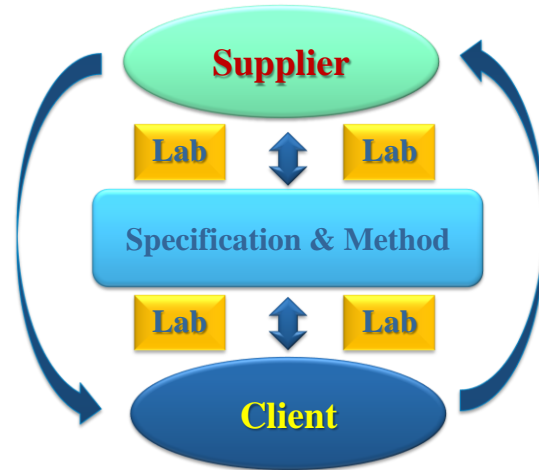
Background: The Importance of Fuel Quality

- The fuel is an engineering element - an essential part in the engineering process
 - *choice of materials*: metallic materials, polymers, lubricants...
 - the fuel properties dictate limits for *engine calibration and optimisation*: emissions, power output, driveability....
- The fuel is an integrated part of the quality assurance system
 - *technical functionality and performance*: vehicle manufacturers have a responsibility visavis to their customers
 - *emissions*: not deterioration over engine life (in-use compliance)
 - *warranty* issues

Background: The Importance of Fuel Quality

- How to secure good performance over the whole engine life-time?
 - the **vehicle manufacturers**:
 - should give *clear instructions* on what fuel to use
 - the **customer**
 - should always *use specified/recommended fuels*.
 - the **fuel marketers**
 - should always (and everywhere) *provide good quality fuels*.
- *Standardisation and harmonisation* ←

Client-Supplier-Relationship



Reliability, Traceability, Uncertainty of Measurement

Mandatory of biofuel utilization

According to Minister of Energy and Mineral Resources
Regulation No. 32/2008

Biodiesel (B100)

	Oct. 2008 until Dec. 2008	January 2009	January 2010	January 2015**	January 2020**	2025**	Note
Household	-	-	-	-	-	-	
PSO Transportation	1% (existing)	1%	2,5%	5%	10%	20%	With respect to total demand
Non PSO Transportation	-	1%	3%	7%	10%	20%	
Industrial and Commercial	2,5%	2,5%	5%	10%	15%	20%	
Generating Electricity	0,1%	0,25%	1%	10%	15%	20%	

Mandatory of biofuel utilization

According to Minister of Energy and Mineral Resources
Regulation No. 32/2008

Biethanol (E100)

	Oct. 2008 until Dec. 2008	January 2009	January 2010	January 2015**	January 2020**	2025**	Note
Household	-	-	-	-	-	-	
PSO Transportation	3% (existing)	1%	3%	5%	10%	15%	With respect to total demand
Non PSO Transportation	5%	5%	7%	10%	12%	15%	
Industrial and Commercial	-	5%	7%	10%	12%	15%	
Generating Electricity	-	-	-	-	-	-	

Example in EU:

Ethanol for EN228 vs. CWA15293

- Ethanol according to prEN15376 intended for use at only 5% blend.
- Higher ethanol concentration fuels may not be able to use prEN15376 ethanol due to impurity concentrations. These may include:
 - Water; Involatile residue; Methanol; Inorganic chloride; Copper; Phosphorus
 - Example: inorganic chloride
- Vehicle fuel systems only robust to 1 mg/L inorganic chloride
 - CWA15293 specifies 1 mg/L max
 - Ethanol sourced against prEN15376 has max 20 mg/L inorganic chloride
 - = 1 mg/L @ 5% ethanol => 2 mg/L @ 10% => 3 mg/L @ 15%
 - = 17 mg/L @ 85% ethanol. According to the automotive producer => *Much too high!!! (in case it would be applied)*

CWA: CEN Workshop Agreement (CWA)

prEN 15376 Ethanol

General applicable requirement and test method

Property	Unit	Limit		Test Method
		Min.	Max.	
Ethanol content + higher saturated alcohols	% (m/m)	98,7		EC/2870/2000 – Method I, Appendix II, Method B
Higher saturated (C3-C5) monoalcohol content	% (m/m)		2,0	EC/2870/2000 – Method III
Methanol content	% (m/m)		1,0	EC/2870/2000 – Method III
Water content	% (m/m)		0,300	EN 15489
Inorganic chloride content	mg/l		20,0	EN 15484
Copper content	mg/kg		0,100	EN 15488
Total acidity (expressed as acetic acid)	% (m/m)		0,007	EN 15491
Appearance		Clear & bright		Visual inspection
Phosphorus content	mg/l		0,50	EN 15487
Involatile material content	mg/100 ml			EC/2870/2000 – Method II
Sulphur content	mg/kg			EN 15485 or EN 15486

ASTM D 4806 Anhydrous denatured

Properties	Specification	Method
Ethanol volume %,	min 92.1	D 5501
Methanol, volume %.	max 0.5	
Solvent-washed gum, mg/100 ml	max 5.0	D 381
Water content, volume %,	max 1.0	E 203
Denaturant content, volume %,	min 1.96 volume %, max 4.76	
Inorganic Chloride content, mass ppm (mg/L)	max 40(32)	D 512
Copper content, mg/kg	max 0.1	D1688
Acidity (as acetic acid CH ₃ COOH), mass percent(mg/L),	max 0.007 (56)	D1613
pHe	6.5-9.0	D 6423
Appearance	visibly free of suspended or precipitated contaminants (clear & bright)	

Current Status: Bioethanol Denaturated for Gasohol (SNI DT 27-0001-2006)

Nr.	Properties	Unit, min./max.	Specification
1	Ethanol content	% vol., min.	99.5 (before denaturation) 94 .0 (after denaturation)
2	Methanol content	mg/mL, max.	300
3	Water content	% vol., max.	1
4	Denaturant content	% vol., min. % vol., max.	2 5
5	Copper (Cu) content	mg/kg, max.	0.1
6	Acidity as Acetic Acid (CH ₃ COOH)	mg/L, max.	30
7	Appearance		Clear, bright and no precipitate and contaminant
8	Chloride content	mg/L, max.	40
9	Sulfur content	mg/L, max.	50
10	Gum content, washed.	mg/100 ml, max.	5.0
11	pHe		6.5 – 9.0

Current Status: Indonesian Biodiesel Standard (SNI 04-7182-2006)

No.	Properties	Unit	Value	Method
1	Density (40 °C)	kg/m ³	850 – 890	ASTM D 1298
2	Viscosity (40 °C)	mm ² /s (cSt)	2.3 – 6.0	ASTM D 445
3	Cetane Number		min. 51	ASTM D 613
4	Flash point (close cup)	°C	min. 100	ASTM D 93
5	Cloud point	°C	max. 18	ASTM D 2500
6	Copper Strip Corrosion (3 hr, 50 °C)		max. no 3	
7	Carbon residu ASTM D 4530 - sample - 10 % dist. residue	%-mass	max 0.05 (max. 0.3)	ASTM D 130
8	Water & Sediment	%-vol.	max. 0.05*	ASTM D 2709 or ASTM D 1796
9	Distillation temperature, 90 % recovered	°C	max. 360	ASTM D 1160

Current Status: Indonesian Biodiesel Standard (SNI 04-7182-2006) – cont'd

No.	Parameter	Unit	Value	Method
10	Sulphated Ash	%-mass	max. 0.02	ASTM D 874
11	Sulphur	ppm (mg/kg)	max. 100	ASTM D 5453 or ASTM D 1266
12	Phosphorous Content)	ppm (mg/kg)	max. 10	AOCS Ca 12-55
13	Acid Number (NA)	mg-KOH/g	max. 0.8	AOCS Cd 3-63 or ASTM D 664
14	Free Glycerin	%-mass	max. 0.02	AOCS Ca 14-56 or ASTM D 6584
15	Total Glycerin (Gttl)	%-mass	max. 0.24	AOCS Ca 14-56 or ASTM D 6584
16	Ester Content	%-mass	min. 96.5	Calculated*
17	Iodine Number	%-mass (g-I ₂ /100 g)	max. 115	AOCS Cd 1-25
18	Halphen test		Negative	AOCS Cb 1-25

$$\text{*Ester Content (\% - mass)} = \frac{100(N_s - N_A - 4.57G_d)}{N_s}$$

*Ns = Saponification Number, mg KOH/g biodiesel, method AOCS Cd 3-25

Effects of Biofuels on Engines

Ethanol in Gasoline

- **Increases volatility**
 - Drive ability impact
 - evaporative emissions impact
- **Water content increased**
 - corrosion of components
 - water separation, engine damage

Biodiesel in petroleum-based Diesel fuel

- **less stable than conventional Diesel fuel**
 - injector fouling, engine power loss
- **impurities,**
 - catalyst damage
- **boiling characteristics**
 - engine oil dilution, engine damage



Next Steps

- Create a new diesel fuel standard to permit for example B10
- Review current biodiesel standard to allow a wider feedstock base (jathropa, coconut, etc.)
- Create a new standard for gasoline permitting E10
- Modify current ethanol standard for use at all percentage blends
- Create a Indonesian standard for E85 fuel for the possible next stage.



Necessary for Indonesia: Biodiesel

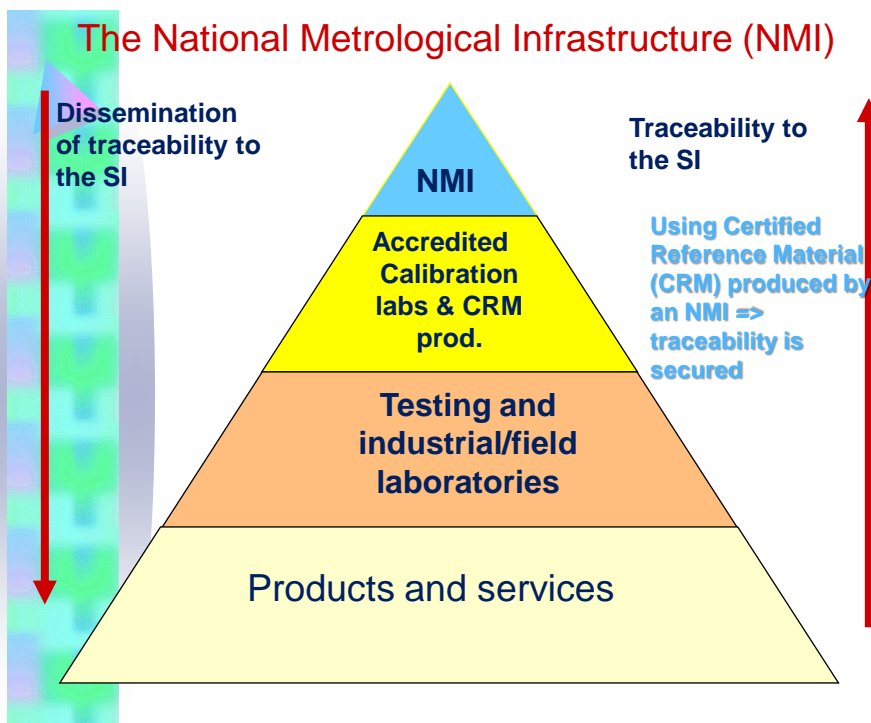
- Base of materials:
 - Palm oil, jathropa, etc
- Packaged (for example in 25 mL amber ampoules)
- Expect certification of sulfur, sodium, potassium, calcium, magnesium, phosphorus, glycerin, tryglycerides, and fatty acid methyl esters (FAMES) (C12 to C24)
- Calibration solution SRMs containing FAMES related to biofuels for composition analysis

Indonesian Biofuel Standards?

- Engine requirements in terms of fuel are the same the world over - see World Wide Fuel Charter
- The engine constraints mentioned earlier incite engine makers to demand fuels of very high quality
- Biofuel producers must recognize and follow this trend if they wish to access the market. If automobile owners associate biofuel with vehicle problems, there is not any future for biofuels
- Indonesian biofuel standards may be possible, but only at high quality levels consistent with engine requirements
 - Ethanol sourced has max 40 mg/L inorganic chloride (SNI 04-7182-2006)
 - = 2 mg/L @ 5% ethanol => 4 mg/L @ 10% => 6 mg/L @ 15% (If not well control, excess of chloride may affect the engine!)

To ensure the fulfillment of standard, in every measurement a reference material is necessary

The National Metrological Infrastructure (NMI)



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METROLOGY IN CHEMISTRY IN INDONESIA

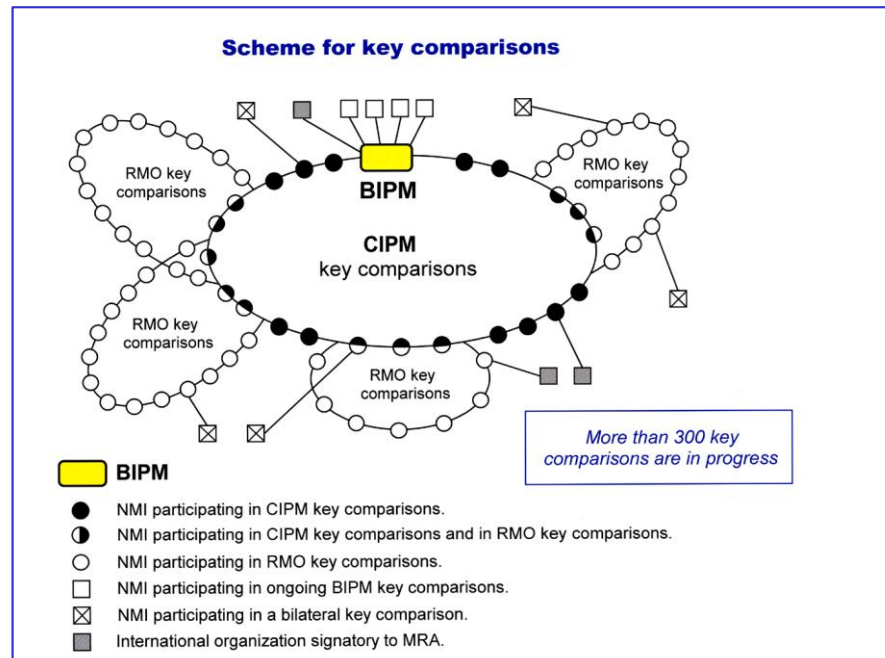
- Research Centre for Chemistry – LIPI is the institute in Indonesia so far which has been engaged in metrology in chemistry activities, i.e. since 1998.
- Another is PPOMN (National Control Laboratory of Drug and Food) producing secondary reference substances traceable to the WHO International Reference Substances and other primary international reference standards for pharmaceutical analysis.

Activities Related to Metrology in Chemistry

The primary activities at LIPI have been of the development of reference materials for chemical analysis.

Activities are presently focused for use in the field of :

- environmental analysis
- food analysis
- biofuel analysis.





Concluding Remarks

- **Fuel standardisation is a must** for long term success in the marketplace
- **The link between fuel quality and vehicle performance (including emissions)** has to be properly taken into account
- This applies to biofuels as well as to conventional fuels
- **Global regulations** for fuel quality. Contribution from the Automotive industry: *World-wide Fuel Charter*
- **To assure the measurement and traceability: Reference Material is necessary => RCChem LIPI is ready**
 - *Decrease uncertainty of measurement*
 - *Reduce risk of legal dispute in business and community*



Terima kasih!
Vielen herzlichen Dank!