

# Suitable Biodiesel Properties for B10 Usage in Vehicle

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**Tom KAKIHARA**

**Japan Automobile Manufacturers Association  
JAMA**

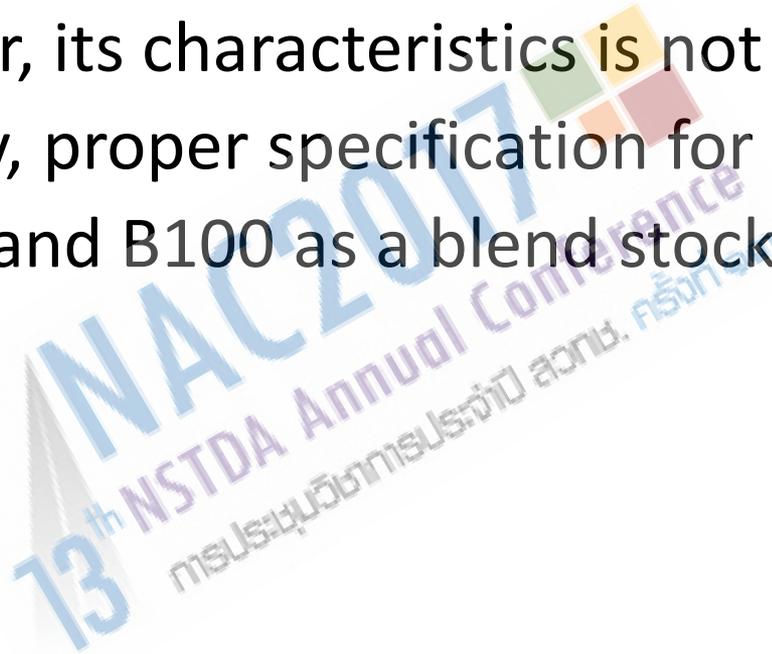
- **Introduction**
- **Characteristics**
  - *Effect to Vehicle*
  - *Easy to Oxidize & Deteriorate*
  - *Easy to Produce Precipitate*
  - *High Boiling Point*
  - *High Capability in Water Absorption*
  - *Low Calories*
  - *High Solubility*
- **Recommendations**
  - *B10 Properties*
  - *House Keeping*
- **Summary**

## Market Fuel Quality

- Market fuel quality is very important for vehicle operation in order to be driven with desire performances not only emissions/ performances/fuel consumption but also durability/reliability of entire vehicle systems.
- To make market fuel quality appropriate, fuel properties have to be controlled by fuel standards with proper limit.
- Fuel quality at S.S. (pump) just before fueling in to vehicles, must be the same as quality just after production at facilities.

## FAME

- Visually, FAME looks similar to conventional diesel fuels however, its characteristics is not the same.
- Consequently, proper specification for both B10 as a finished fuel and B100 as a blend stock for B10 are needed.



- ✓ FAME has unique characteristics and it would impact on fuels system components and vehicle operations.

*Characteristics of FAME		Possible Effect	
1	Easy to oxidize and deteriorate	Corrosion of parts , Adhesion of deposits	
2	Easy to produce precipitate	Clogging fuel filters	
3	High capability in water absorption	Rust, Corrosion, Microbial growth, Clogging fuel filter	
4	High Boiling Point	Incomplete combustion, Oil dilution (by DPF Regeneration)	
5	Low Calories (Low LHV**)	Low efficiency, Lower exhaust gas temperature	
6	High Solubility	Peeling off sludge, clogging fuel filter	

\*Comparison with conventional diesel fuels \*\*LHV : Lower Heating Value)

✓ **Chemical reaction has to be restricted to make fuel quality stable.**

□ **Double Bond Components**

- FAME can be degraded by chemical reaction of double bond components.

□ **High Reactivity**

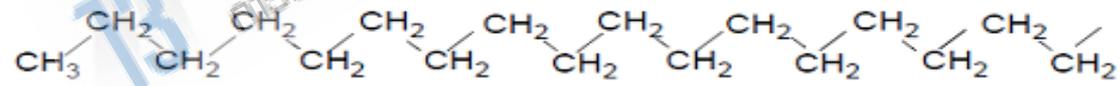
- Double bond components can easily initiate chemical reaction when conditions are met.

□ **Acids and Sludge Generation**

- Acid and sludge will be produced. Acid will attack materials, sludge leads clog filters, and form deposits in the fuel system.

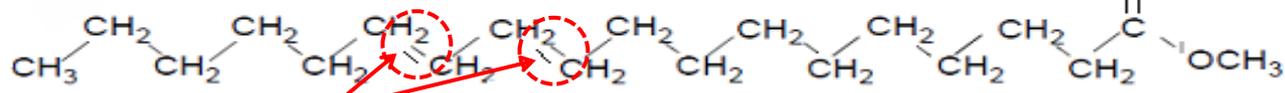
Diesel fuel Structural

Example ⇒ RH



FAME Structural

Example ⇒ R-COO-R'

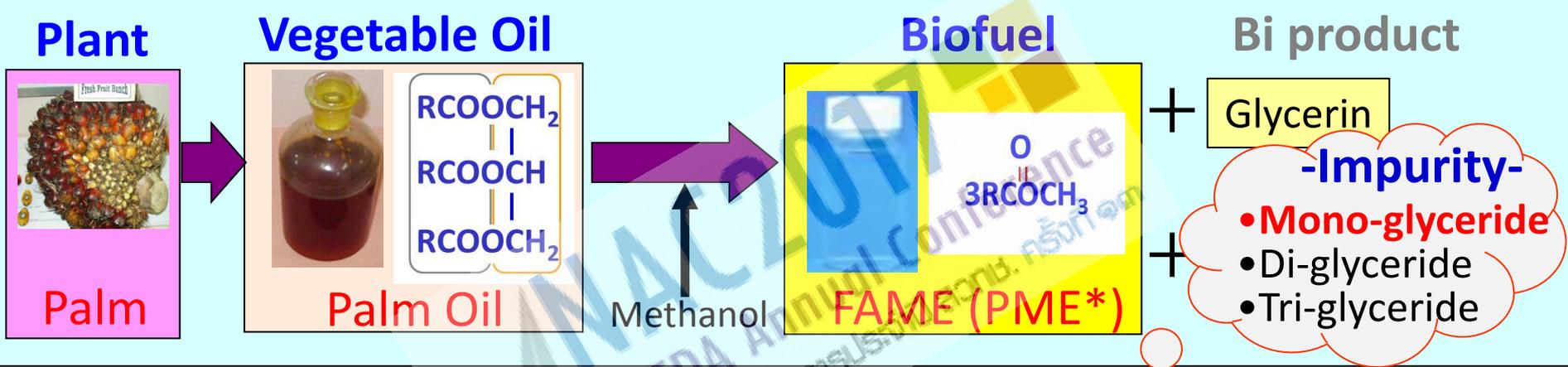


**Double Bond** Double bond is extremely high reactivity.

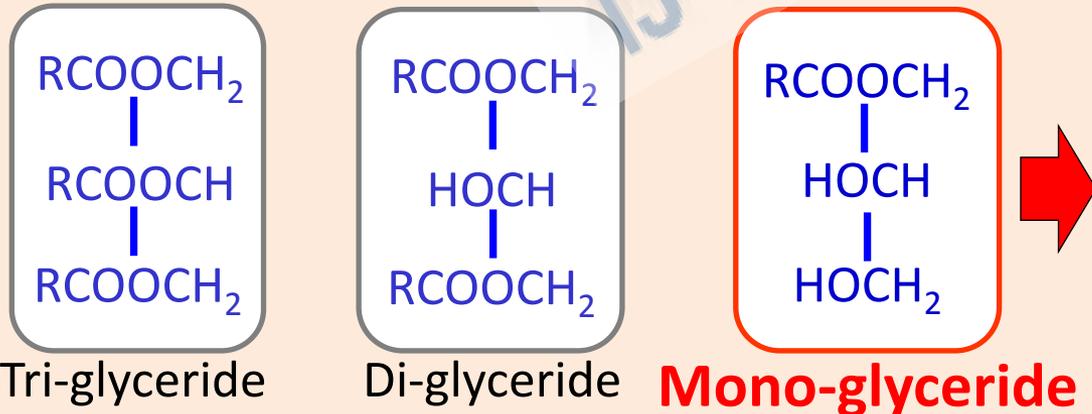
➤ **10 hr for B100/35hr for B10 by Rancimat are recommended as oxidation stability in the standards.**

✓ Mono-glyceride (MG) content in B100 has to be controlled because MG becomes solid (Precipitate) at room temperature.

## ◆ Production Process



## ◆ Glycerides = Impurity



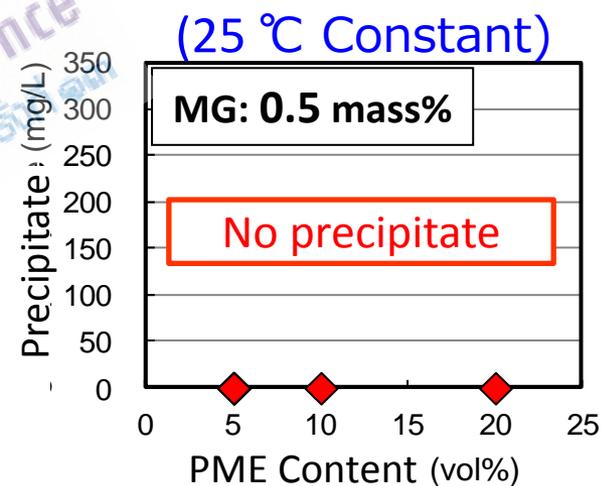
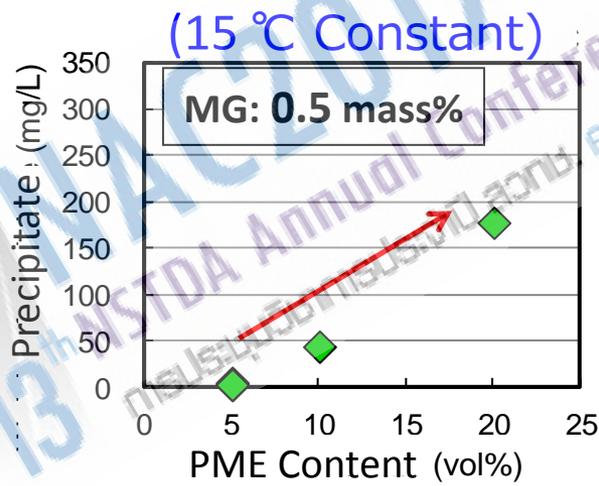
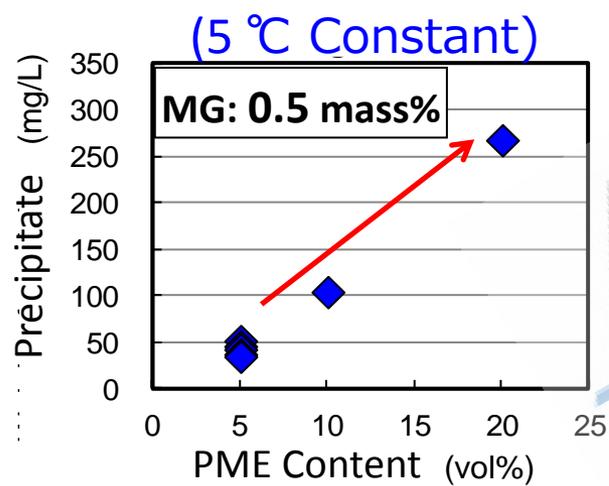
✓ Melt into FAME but not melt in light oil  
 ✓ Solid at room temp

- ✓ Proper specification for Mono-glyceride content in B100 is needed to prevent clogging filter issue by precipitate.
- ✓ There are three key factors to determine precipitate amount.

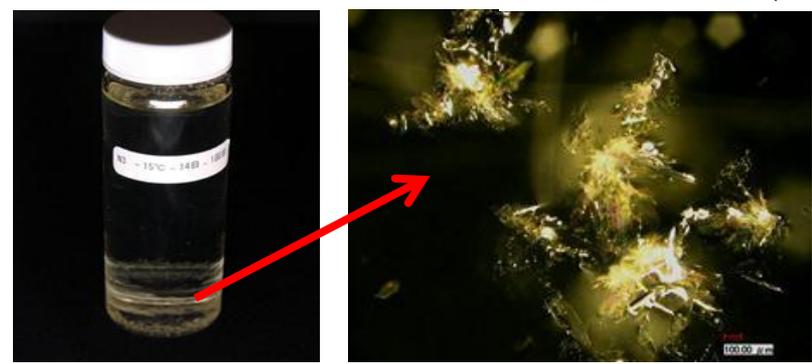
## Factors

- **FAME content (= MG content):**
  - B7, B10....., Bxx
- **Temperature:**
  - Northern & High Elevation regions
- **Aromatics content in base diesel:**
  - Lower sulfur contained diesel fuels

- ✓ Precipitate amount is determined by FAME content and storage temperature.
- ✓ Automobile manufacturers expectation is no precipitate at all in the country, since precipitate is one of solid debris in fuel.



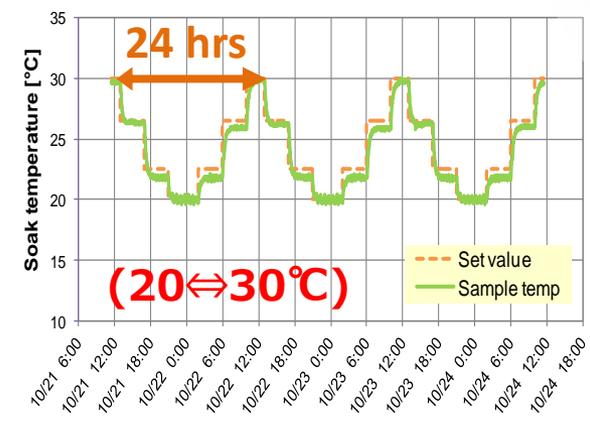
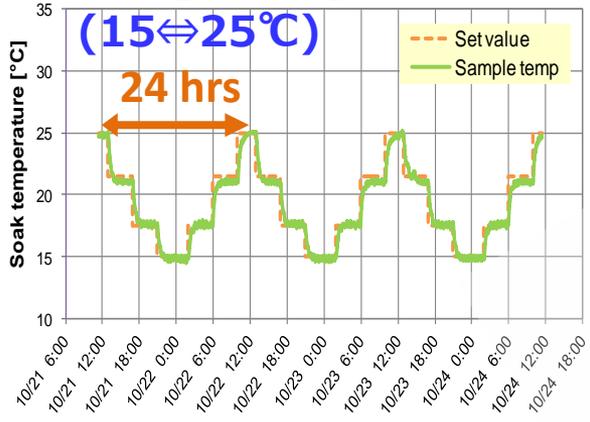
• Note: No precipitate was observed with 0.13 mass % MG in PME.



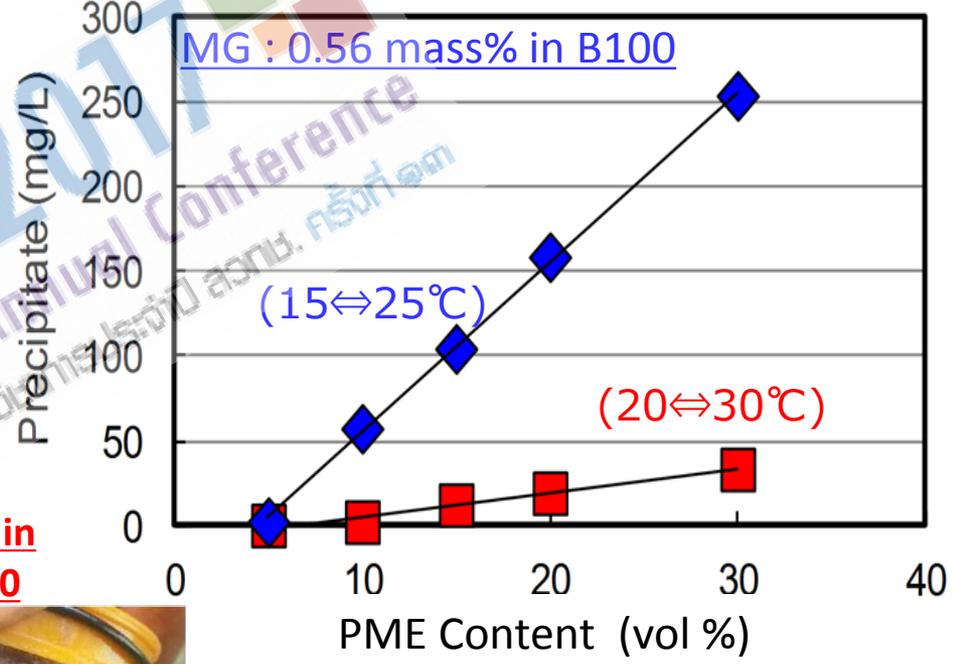
Source: JAMA

- ✓ Precipitate was found with simulated real world temperature profile as well.
- ✓ Temperature profile in Malaysia and Indonesia were simulated.

## Storage Temp. Profile



## Precipitate Amount *Source: JAMA*



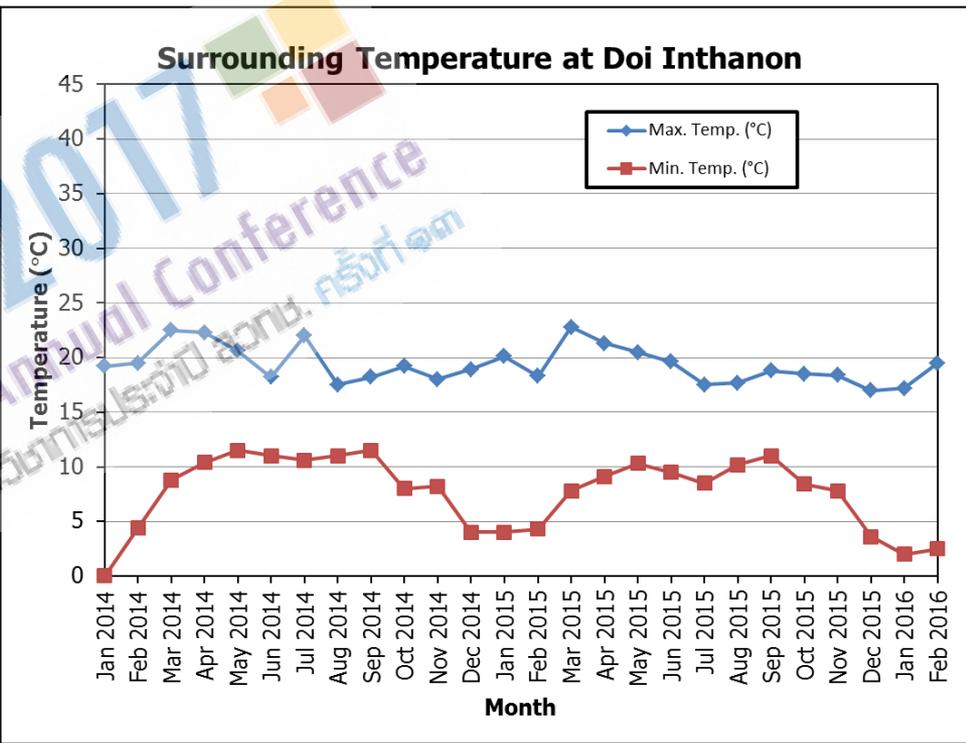
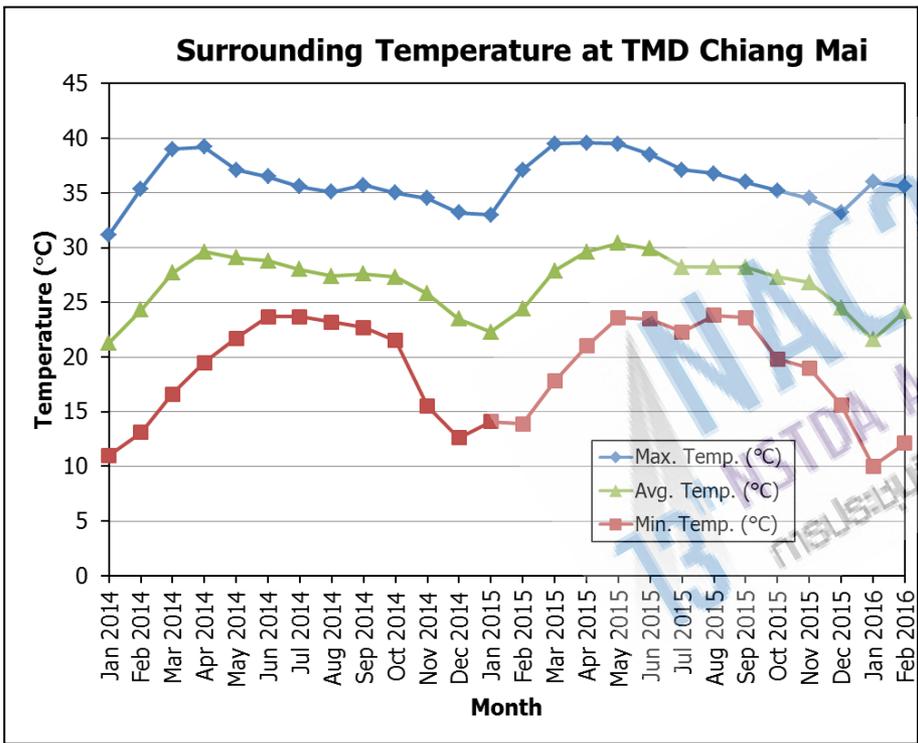
**Field incident in Indonesia B20**



**Precipitate**

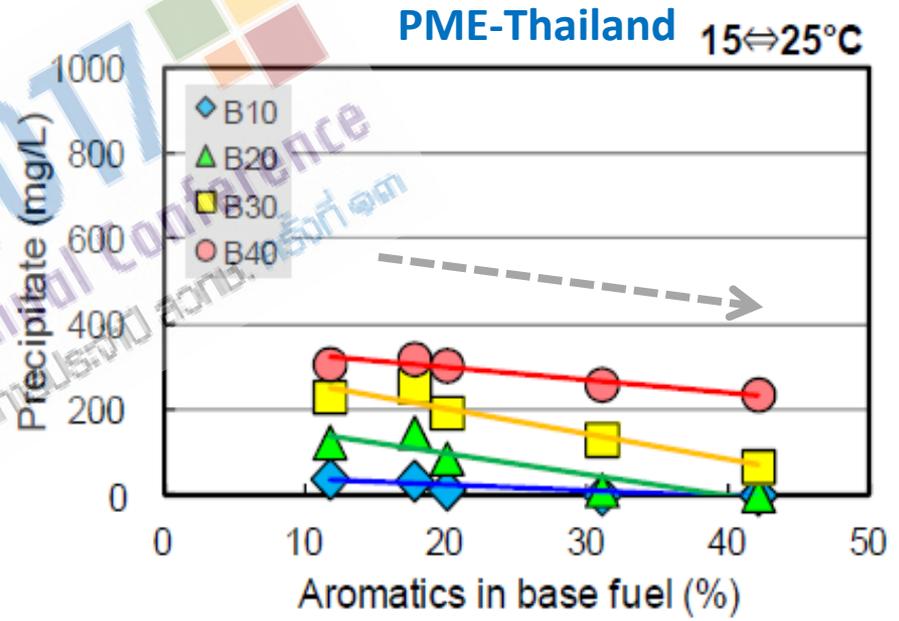
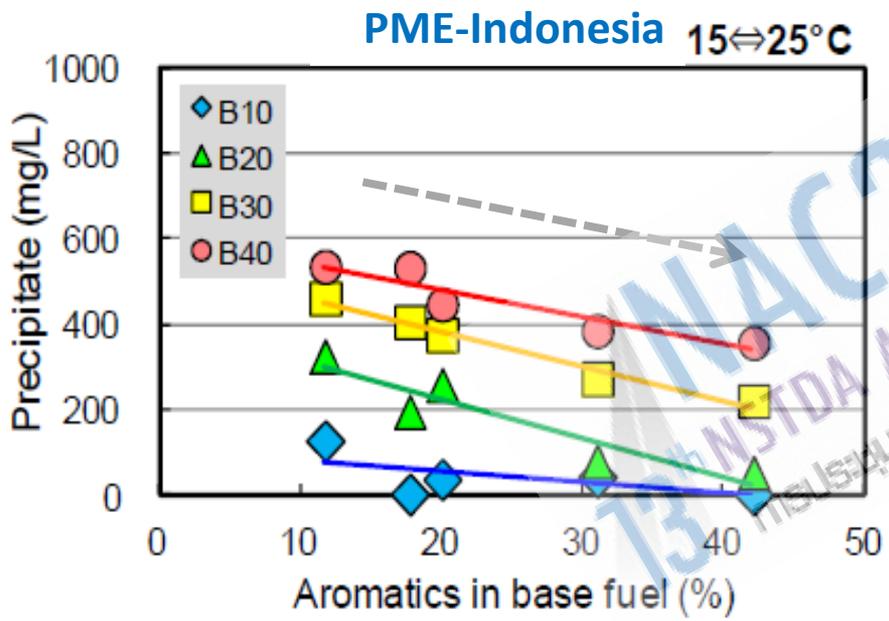
- ✓ Climate temperature in Thailand is lower than in Malaysia and Indonesia and condition in Thailand would be more severe.

## Temperature in Chiang Mai



➤ Real world verification test is recommended to determine MG limit.

- ✓ Aromatics content in base diesel fuel impacts on precipitate amount.



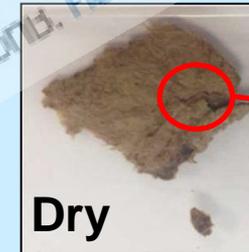
➤ Real world verification test with lower sulfur diesel (i.e. Euro5 diesel) is recommended to determine MG limit.

# □ Characteristics - High Capability in Water Absorption

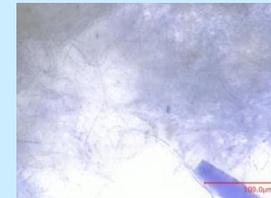
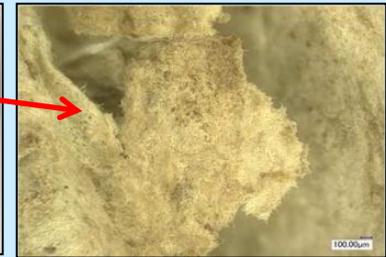
- ✓ Water in fuel is a factor to promote rust/corrosion of materials and microbial growth in fuel tanks.

## ■ Actual Incident at Vehicle Production Plant

- Fuel filter plugged due to foreign material in biodiesel B7 in the underground fuel storage tank at car plant in Thailand.



Dry



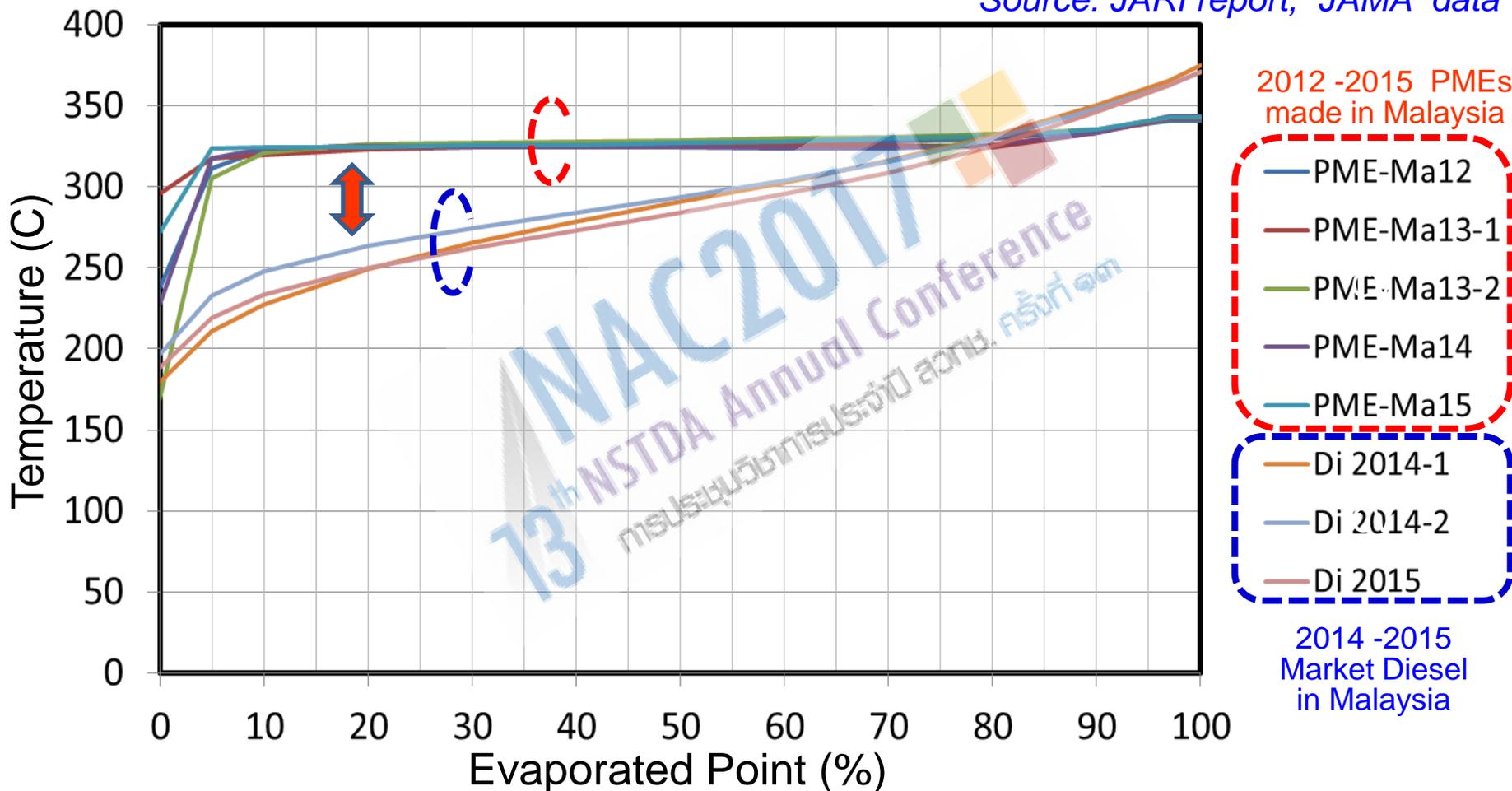
filamentous  
fungus

- 500ppm max. for B100 and 200ppm max. for B10 are recommended.

# □ Characteristics - High Boiling Point

✓ Distillation characteristics of PME is quite different from conventional diesel fuel.

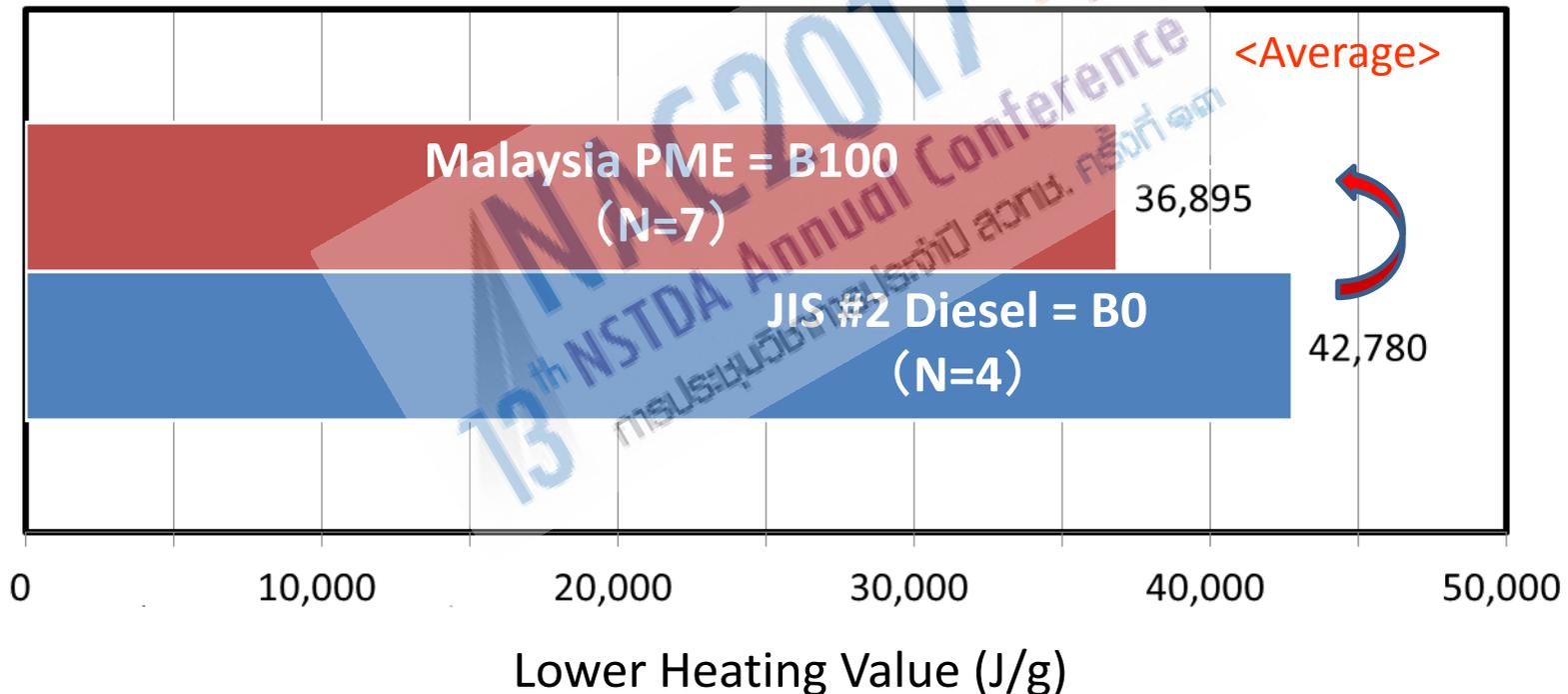
Source: JARI report, JAMA data



➤ Need to keep eye on actual vehicle behavior in the market.  
i.e. drivability, vehicle performances, EGR fouling,

- ✓ Because of unique composition of FAME, theoretically, efficiency is decreased by increasing FAME content.
- ✓ There is no way to compensate the loss as long as FAME is contained.

Source: JARI report



➤ Need to keep eye on actual vehicle behavior in the market.  
i.e. fuel economy, vehicle performances

# □ Characteristics - High Solubility

- ✓ There is no way to control as a specification.
- ✓ Actual incident was occurred during field test in Indonesia and a lots of sludge was trapped on the fuel filter at only 7,500 km driving after switch to B20 from B0.



➤ Need to keep eye on actual vehicle behavior in the market.  
i.e. filter replacement, vehicle performance.

# □ Recommendations – B10 properties

✓ Refer to EN590/EN16734 for other properties.

Characteristics of FAME		Recommendations
1	Easy to oxidize and deteriorate	B100: <u>10 hr min.</u> in Rancimat IP B10: <u>35 hr min.</u> in Rancimat IP* <sup>1</sup>
2	Easy to produce precipitate	Adequate MG limit in B100 std. <u>has to be specified based on real world test result.</u>
3	High capability in water absorption	B100: <u>500ppm</u> max. – Water Content B10: <u>200ppm</u> max. – Water Content
4	High Boiling Point	Keep eye on vehicle behavior in the market* <sup>2</sup>
5	Low Calories (LHV* <sup>3</sup> )	Keep eye on vehicle behavior in the market* <sup>2</sup>
6	High Solubility	Keep eye on vehicle behavior in the market* <sup>2</sup>

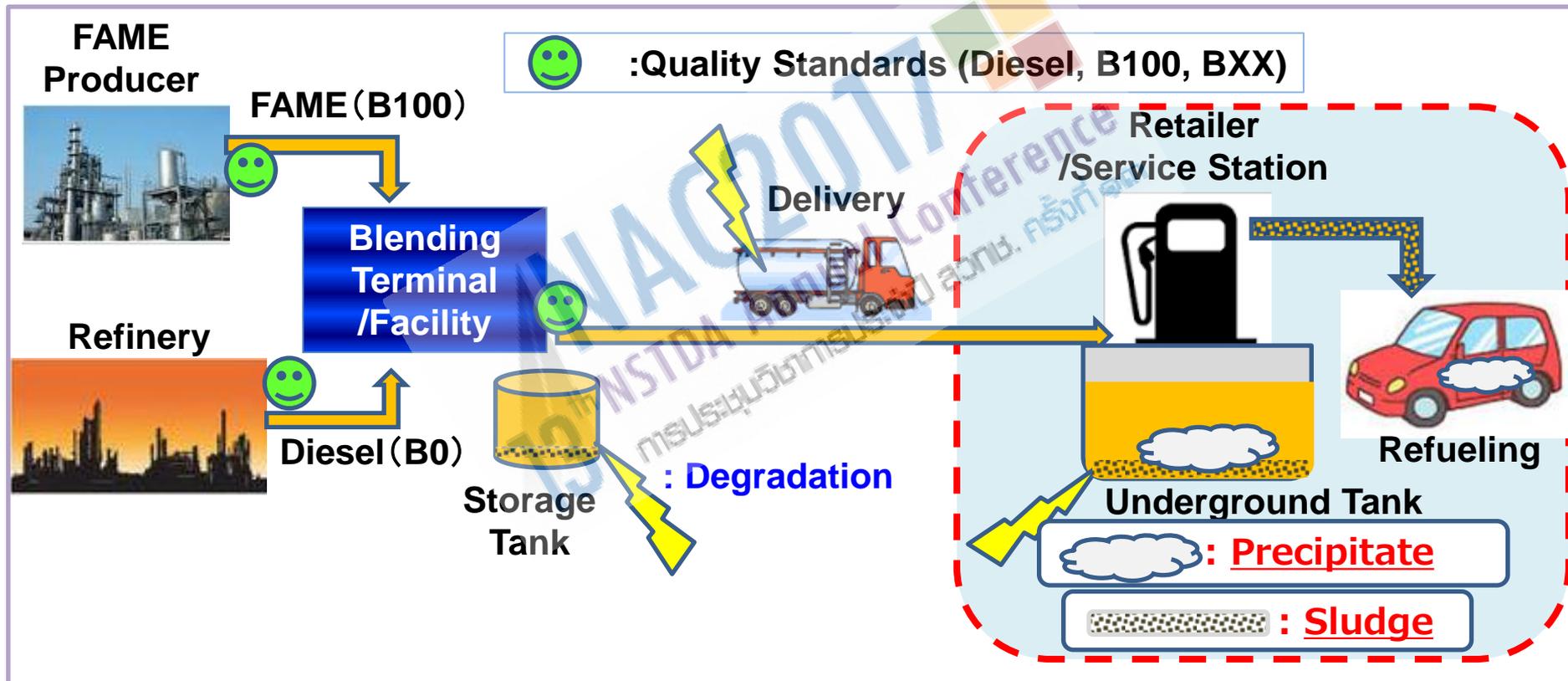
\*Alternative method, 65 minutes < in PetroOXY or 0.12 mgKOH/g max. in Delta TAN is recommended.

\*<sup>2</sup>It is impossible to control property by fuel standard.

\*<sup>3</sup>LHV: Lower Heating Value

# Recommendations – House Keeping

- ✓ Vehicles need to have fuels with expected quality at SS/retailers.
- ✓ Some opportunities to degrade its quality during delivery, handling, and storage process from production facilities to SS.



➤ Inspection/monitoring and maintenance process need to be considered entire process after fuels production.

- The characteristics of FAME is different from conventional diesel fuels and its discrepancy will become large when FAME content is increased.
- Proper limit for the properties in B10 and B100 standards are needed to keep vehicle operation securely.
- Re-consideration of both B100 & Bxx standards will be required when FAME content is increased in the future.
- Establishment of quality control system (monitoring system) for the market fuel needs to be considered to minimize field issues.



Thank you very much  
for your attention

**JAMA**

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