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JAPAN AUTOMOBILE MANUFACTURERS ASSOCIATION, INC.

Concerns for Higher Blends of Biodiesel - Higher FAME Blends -

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Japan Automobile Manufacturers Association
JAMA

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Introduction

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- Recognize in the importance that the use of biodiesel would contributed GHG reduction and saving fossil fuel.
- Minimize any undesired operation of vehicles such as impact on the environment and inconvenience for users in the market.
- Considering and looking for the solution of issues based on technical back data continuously.
- May ask stake holders to understand issues and to take action in order to use biodiesel fuels properly.

☐ Our Position - Statement for Biodiesel Usage

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"Global Statement"

- ✓ **JAMA has been recommending the use of up to 5% (or 7%) of FAME as for general public diesel fuel in order to prevent any inconvenient operation of vehicles for the users.**
- ✓ **FAME which is majority of biodiesel, has unique & different characteristics from fossil based conventional diesel fuel and it would impact on fuel system components & engine/vehicle operations.**
- ✓ **When FAME is blending with low concentration such as 5% in to diesel fuels, the impact by FAME would be minor and may be negligible.**

Our Position - Statement for Biodiesel Usage

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"Supplemental (Regional) Statement"

- ✓ **JAMA has recognized the latest policies in some Southeast Asian region which is mandated to use higher FAME blends.**
- ✓ **In order to be used biodiesel fuel appropriately there, JAMA has decided to publish the "Supplemental Statement" in addition to "Global Statement".**
- ✓ **The "Supplemental Statement" accepts the use of up to 20% of FAME under certain conditions.**

Global Statement

JAMA Position Statement Update, FQ-02, 2015.5.1

JAMA Position on the Market Introduction of Diesel Fuel Containing >5% FAME Blend Concentrations

Fuel & Lubricants Subcommittee
Japan Automobile Manufacturers Association, Inc. (JAMA)

In support of efforts to reduce carbon dioxide (CO_2) emissions and conserve fossil fuel resources and in view of the fact that fatty acid methyl esters (FAME) constitute a renewable energy source, the Japan Automobile Manufacturers Association, as stated in its preceding position statement released in October 2009, endorses the market supply of conventional diesel fuel blended with a maximum of 5% FAME (B5), provided that specific quality requirements are met prior to its delivery at the pump.

JAMA is very concerned, however, that diesel fuel-use policy in various Southeast Asian

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Supplemental Statement

JAMA supplementary position statement (September 2016)

JAMA Position on the Use of Diesel Fuel Blended with FAME Concentrations in Excess of 5%

Fuel & Lubricants Subcommittee
Japan Automobile Manufacturers Association, Inc. (JAMA)

Introduction/Background

JAMA endorses the use of fatty acid methyl esters (FAME) in diesel fuel, because they contribute to reduced carbon dioxide (CO_2) emissions from motor vehicles and thereby help counteract global warming. However, owing to the specific property of FAME blendstocks, JAMA has been recommending that FAME concentrations in diesel fuel not exceed 5% in order not to jeopardize safe

JAMA HP: http://www.jama.or.jp/eco/wwfc/pdf/JAMA_FQ_PositionStatement_FAME.pdf
http://www.jama.or.jp/eco/wwfc/pdf/FAME_JAMA_Supplementary_Position_Statement_December2016.pdf

Our Position - Statement for Biodiesel Usage

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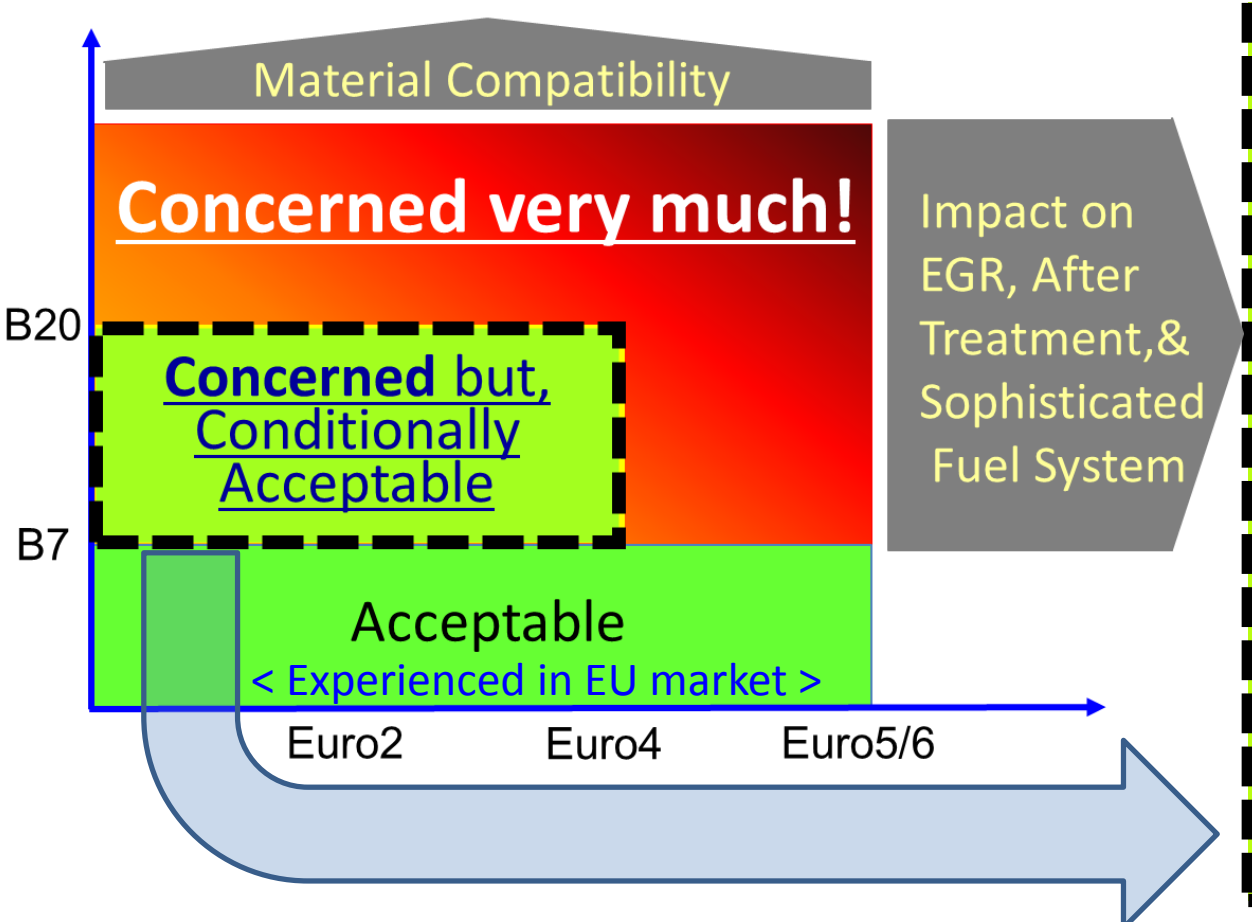
- ✓ **No objection in blending FAME up to 20% when required conditions are met.**
- ✓ **Recommend to keep conventional diesel fuel (i.e. B5 or less) for older vehicles in the market.**



Impact on EGR, After Treatment,& Sophisticated Fuel System

Conditions

"Presupposed Conditions"
- Warm/Hot Climate
- PME
- Up to Euro4/IV emission requirement

"Recommendations"
Measures for….
- Oxidation Stability
- Precipitate
- Solubility

Biodiesel Expansion & Emission Enhancement

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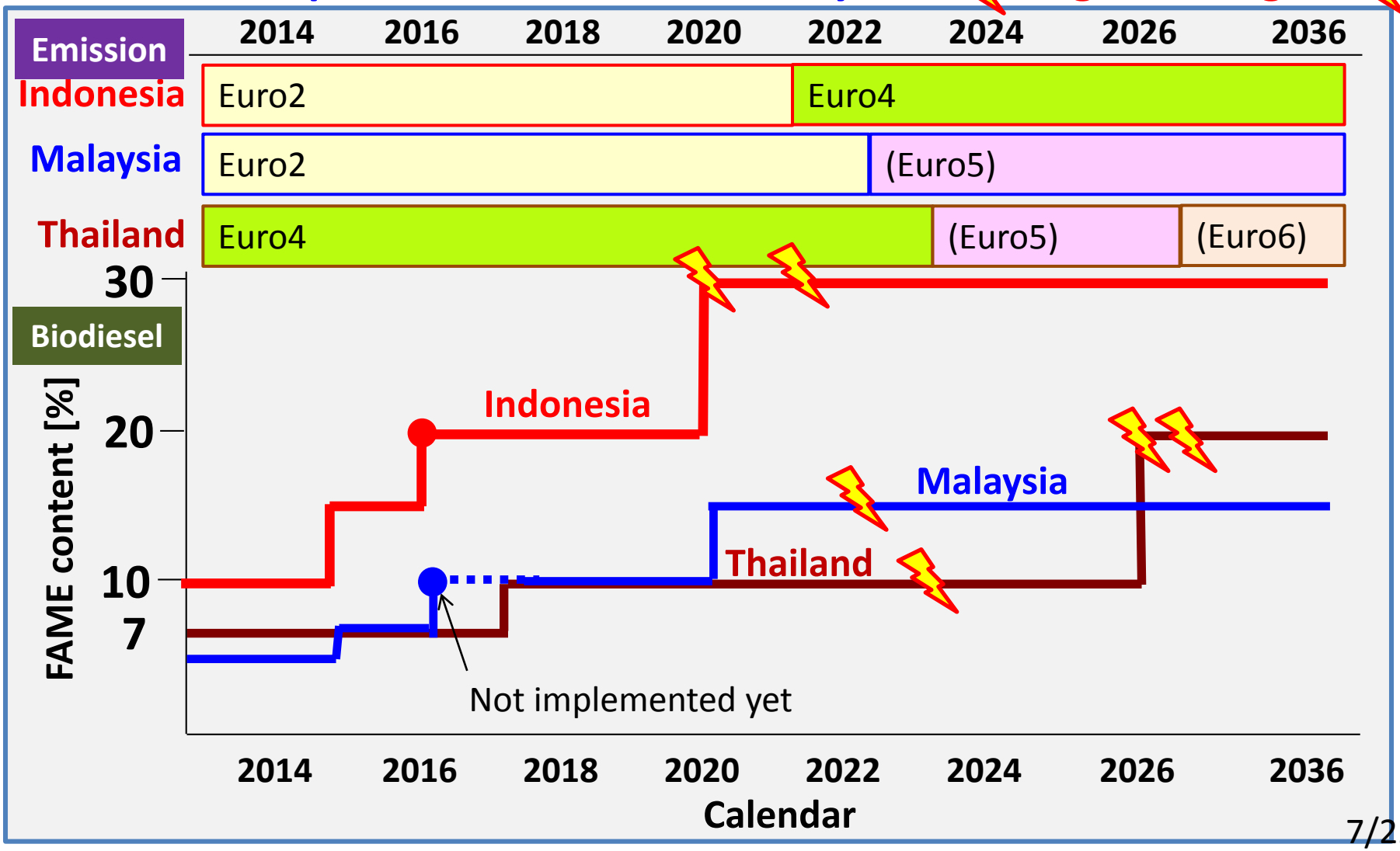
✓ **Moving forward higher blends mandate and more stringent emission requirements simultaneously.**

"Big Challenges!!"



Key Characteristics of FAME

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FAME

- Has unique components and impurities
- looks similar to conventional diesel fuel visually
- Not the same characteristics as conventional diesel fuel

Concerns

- ✓ The unique characteristics of FAME is effected to stability, solubility, and fuel properties such as distillation and LHV.
- ✓ The unique, and different fuel properties from conventional diesel expects to impact on engine combustion characteristics as well.

☐ Key Characteristics

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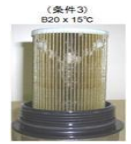
✓ **FAME has unique characteristics and impact of higher blends on components/systems would become noticeable.**

*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 Boiling Point**	Incomplete combustion, Oil dilution (by DPF Regeneration)
4	**High capability in water absorption**	Rust, Corrosion, Microbial growth, Clogging fuel filter
5	**Low Calories**	Low efficiency, Lower exhaust gas temperature
6	**High Solubility**	Peeling off sludge, clogging fuel filter 

**Comparison with conventional diesel fuels*

☐ Key Characteristics - Different Composition

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- ✓ **Stability of FAME is worse than conventional diesel and can be controlled in production process.**
- ✓ **Has to be specified in B100 & Bxx standards as an O-Stability.**

☐ Double Bond Components

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

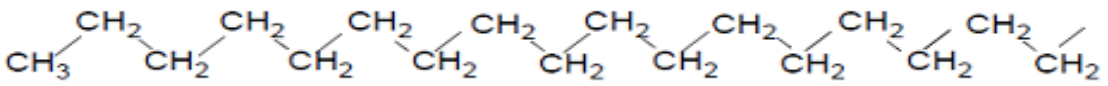
☐ High Reactivity

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

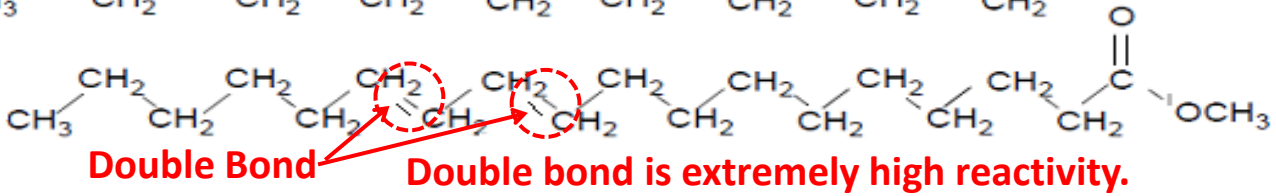
☐ Acids and Sludge Generation

- 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'



☐ Key Characteristics - Containing Impurity

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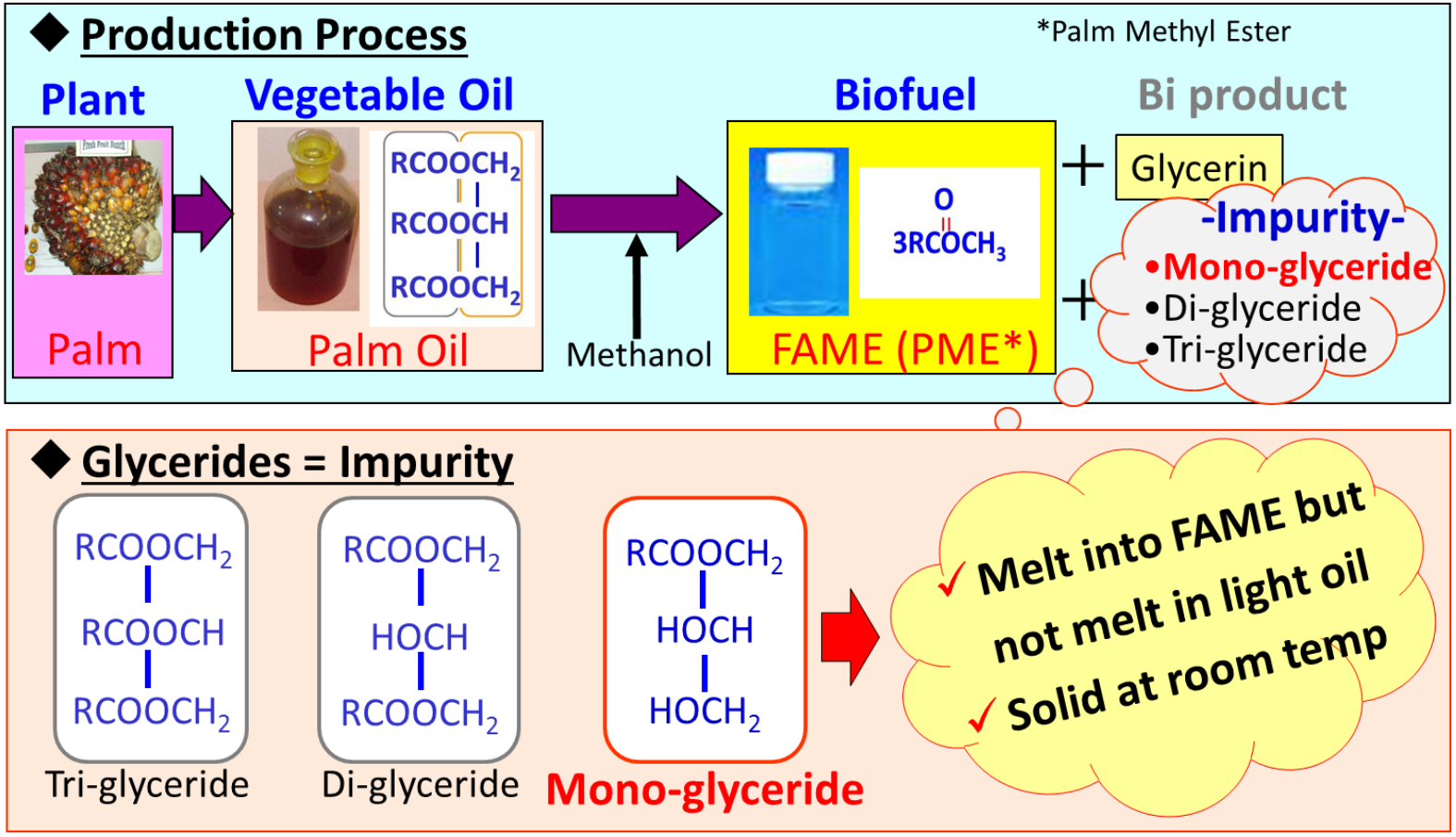
- ✓ **Mono-glyceride (MG) content in B100 becomes solid (Precipitate) at room temperature and can be controlled in production process.**
- ✓ **Has to be specified in the standard based on FAME content in diesel fuel and market climate condition.**



Key Characteristics - Distillation

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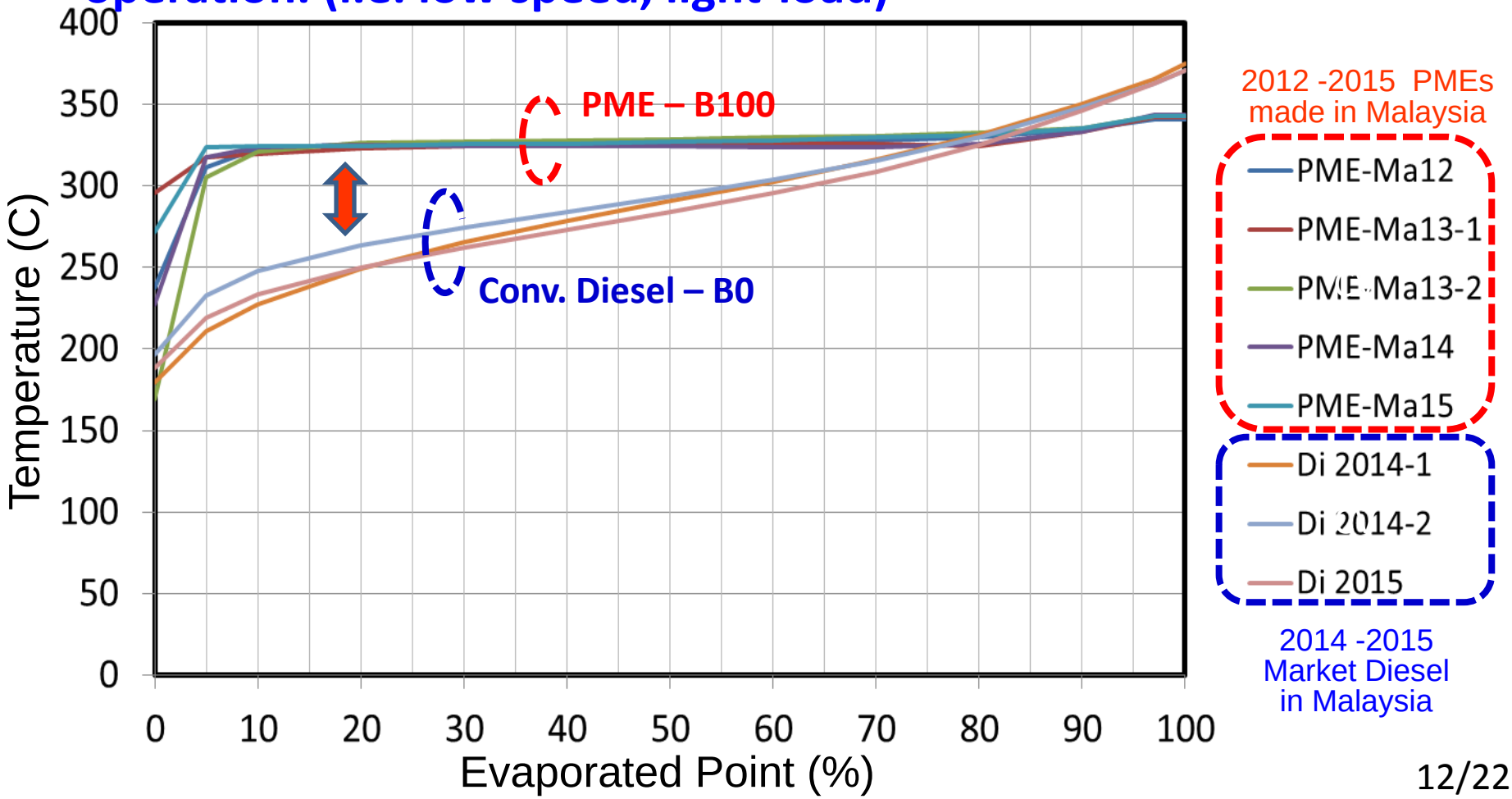
- ✓ **Distillation characteristics of PME is quite different from conventional diesel fuel and CAN'T be controlled in prod. process.**
- ✓ **Expected not to burn completely at low combustion temperature operation. (i.e. low speed, light-load)**



☐ Key Characteristics - LHV

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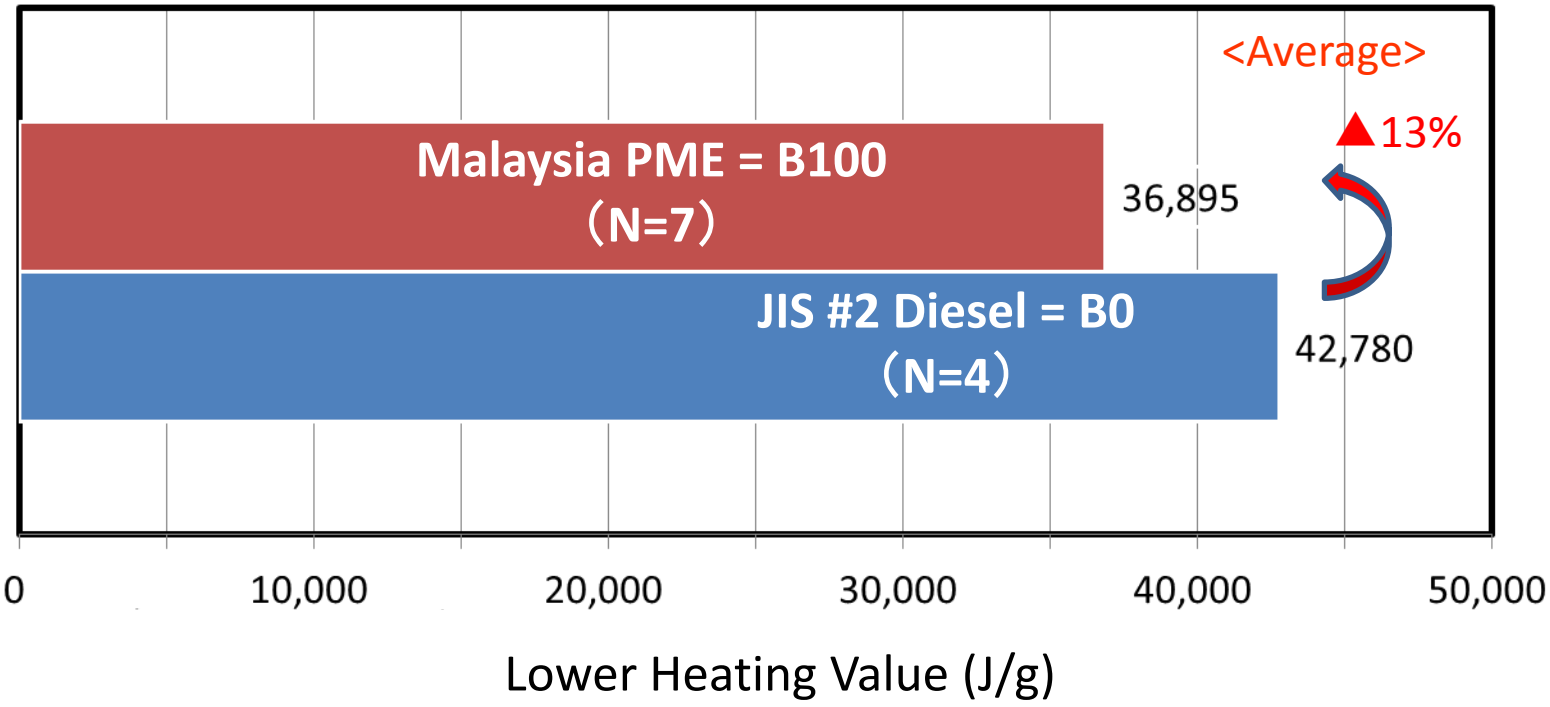
- ✓ **Because of unique composition, FAME has lower energy content and CAN'T be controlled in production process.**
- ✓ **May impact on fuel economy, and vehicle performances**

Source: JARI report



Further Concerns

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- ✓ **Combination of Euro5/6 compliant vehicle and higher FAME blends will be new to Automobile Manufacturers.**
- ✓ **Its impact is unknown.**

Higher FAME Blends

- ✓ Distillation
- ✓ LHV – Lower Calories
- ✓ Oxidation Stability
- ✓ Precipitate

Euro 5/V Vehicles

- ✓ DOC/DPF/SCR
- ✓ Enhanced EGR system
- ✓ Higher Injection Press.
- ✓ More accurate fuel cont.

Note: In general, most of these systems would not be required to meet Euro4.

☐ Further Concerns - Euro5/6 Compliant Vehicles

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Typical Technologies

- ✓ Newly equipped DOC/DPF/SCR/LNT
- ✓ Enhanced EGR system (Hi flow rate, EGR cooler)
- ✓ Higher pressure fuel injection system (Common Rail)
- ✓ Upgraded fuel system – Finer filter, accurate fuel injection, etc.

☐ Further Concerns - Emission Control Technologies

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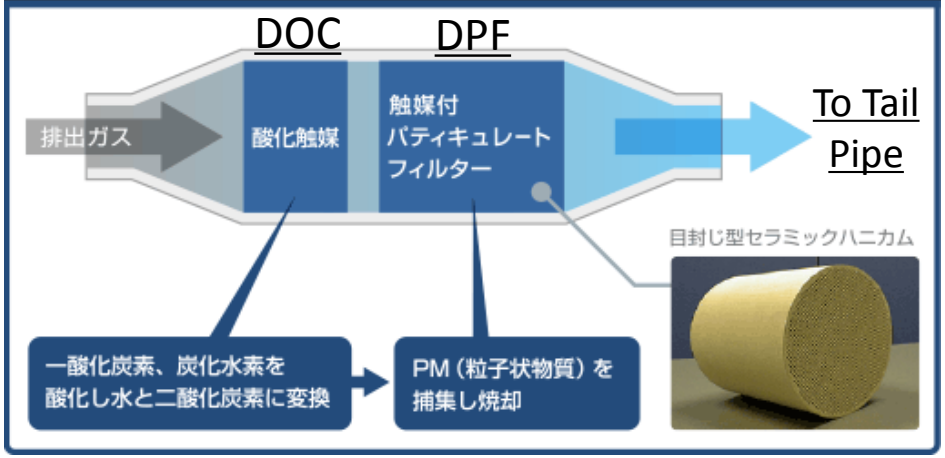
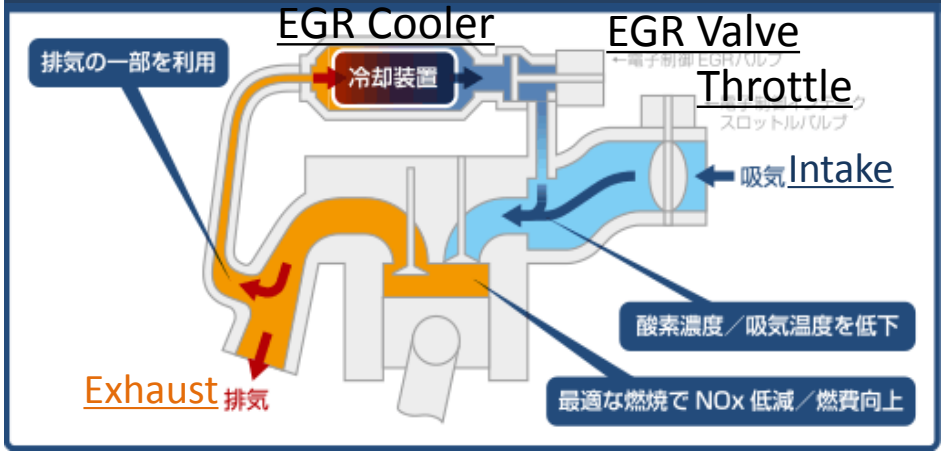
✓ **New technologies to be introduced in the future vehicles compliant to Euro5/6 emission requirements**

Reference: Isuzu HP

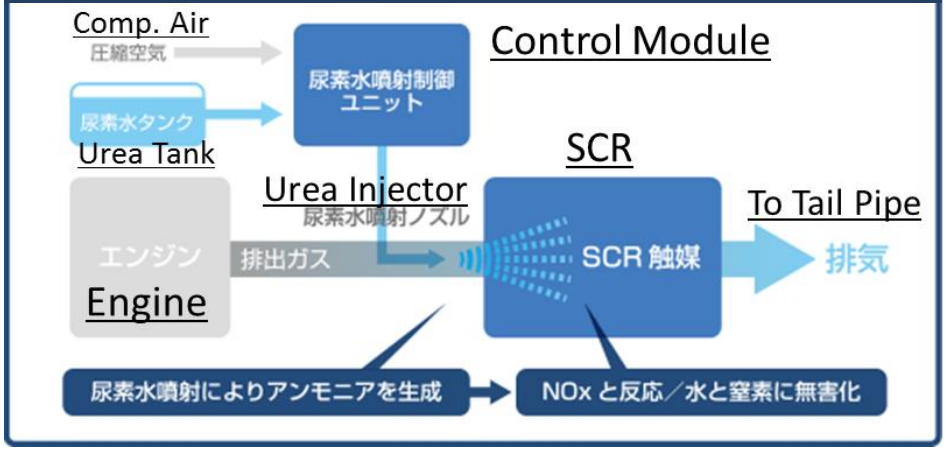
DOC + DPF



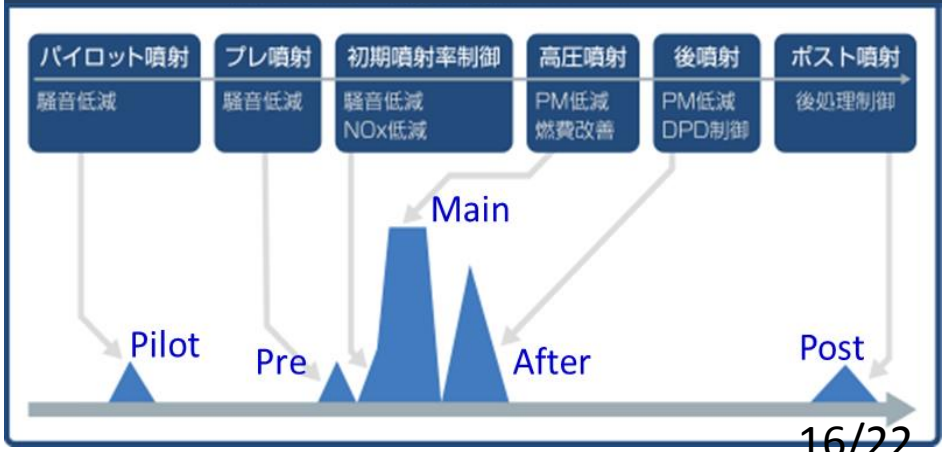
EGR System (valve, cooler, throttle)



Urea SCR



Multiple Injection



☐ Further Concerns - Expected Impacts (1/3)

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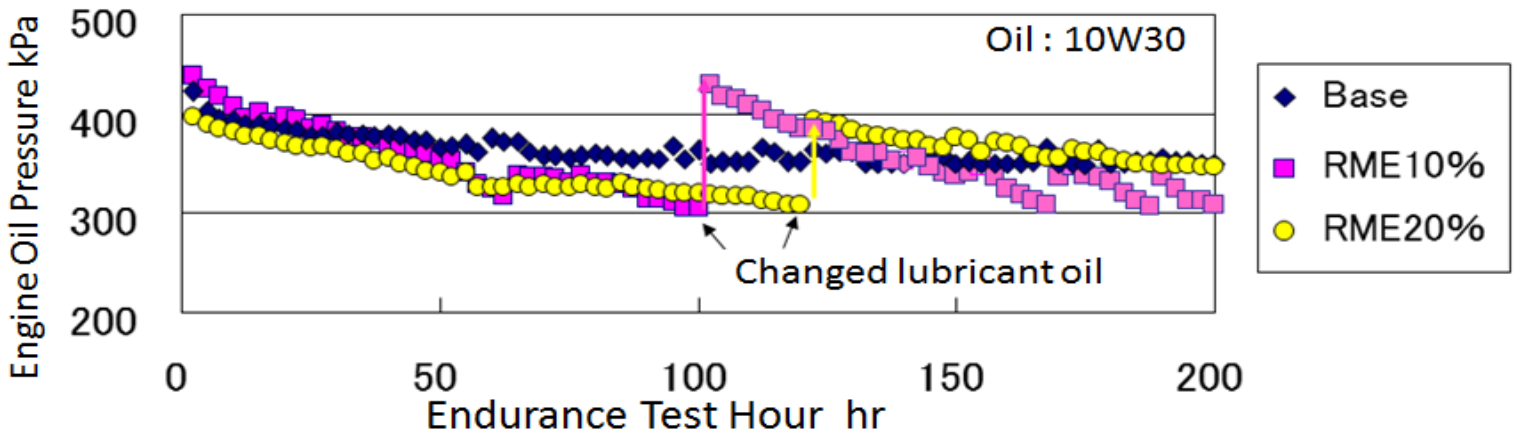
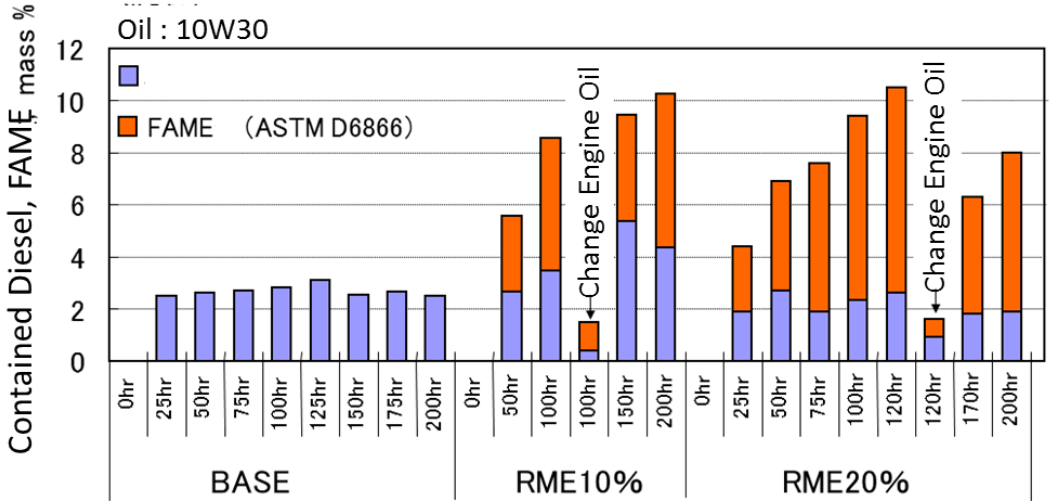
- ✓ FAME contained lubricant oil can not be evaporated and remains.
- ✓ Viscosity of FAME contained lubricant oil is low and leads low press.
- ✓ Especially concerned in vehicles equipped DPF.





Reference : JATOP

☐ Further Concerns - Expected Impacts (2/3)

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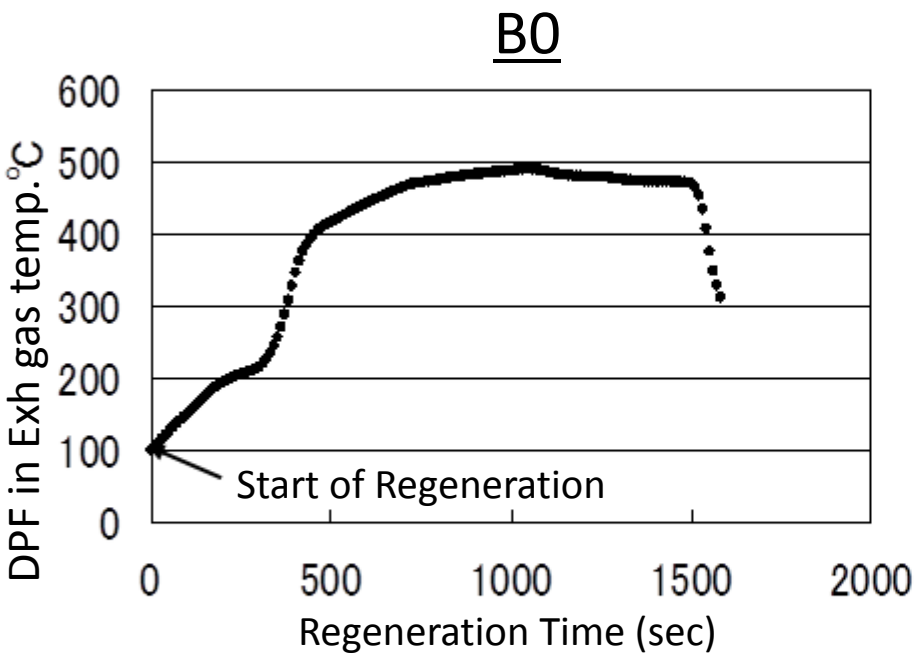
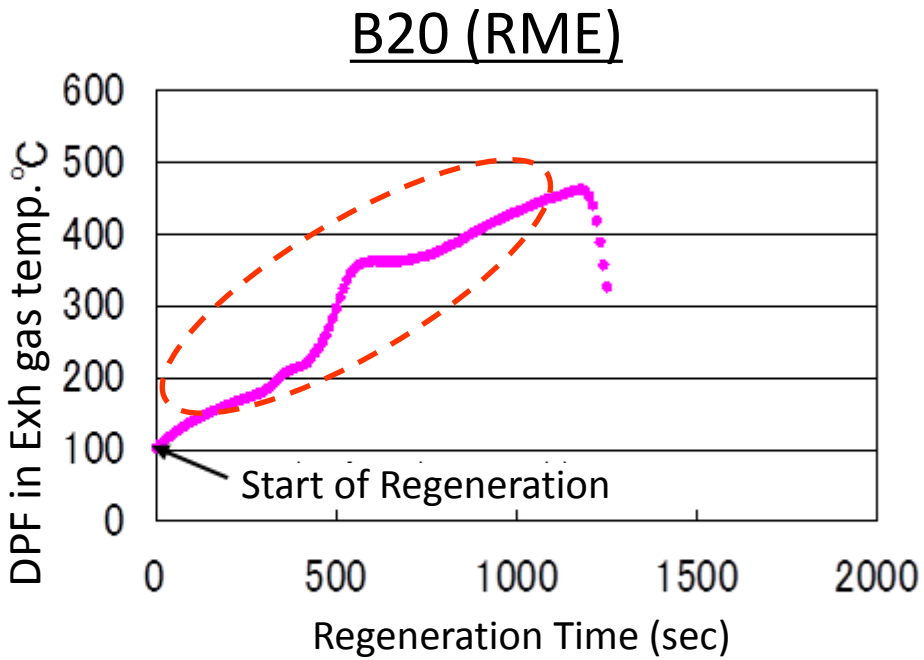
✓ **The profile of exhaust temperature at DPF-in became lower due to lower LHV, when B20 used.**





In case of B20, DPF in Exhaust gas temperature could not reach high enough to complete DPF regeneration

Reference : *JATOP*

☐ Further Concerns - Expected Impacts (3/3)

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✓ **High FAME blends would be expected to impact on newly employed systems and components.**

Key Characteristics	Factor	Expected Impacts
Distillation < High Boiling Point >	• Unburned FAME in Exhaust	• Fouling, clogging EGR system components • Clogging DOC, DPF • Oil dilution by FAME (by DPF regeneration) - Drop of engine oil pressure
LHV < Low Calories >	• Lower Exh. Gas Temperature	• Drop of DPF regeneration performance • Decline in emission conversion rate
Oxidation Stability	• Oxidized Degradation	• Sludge formed in engine oil • Injector deposits - In-cylinder injector - Exhaust pipe injector (for DPF regeneration)

☐ Importance of House Keeping

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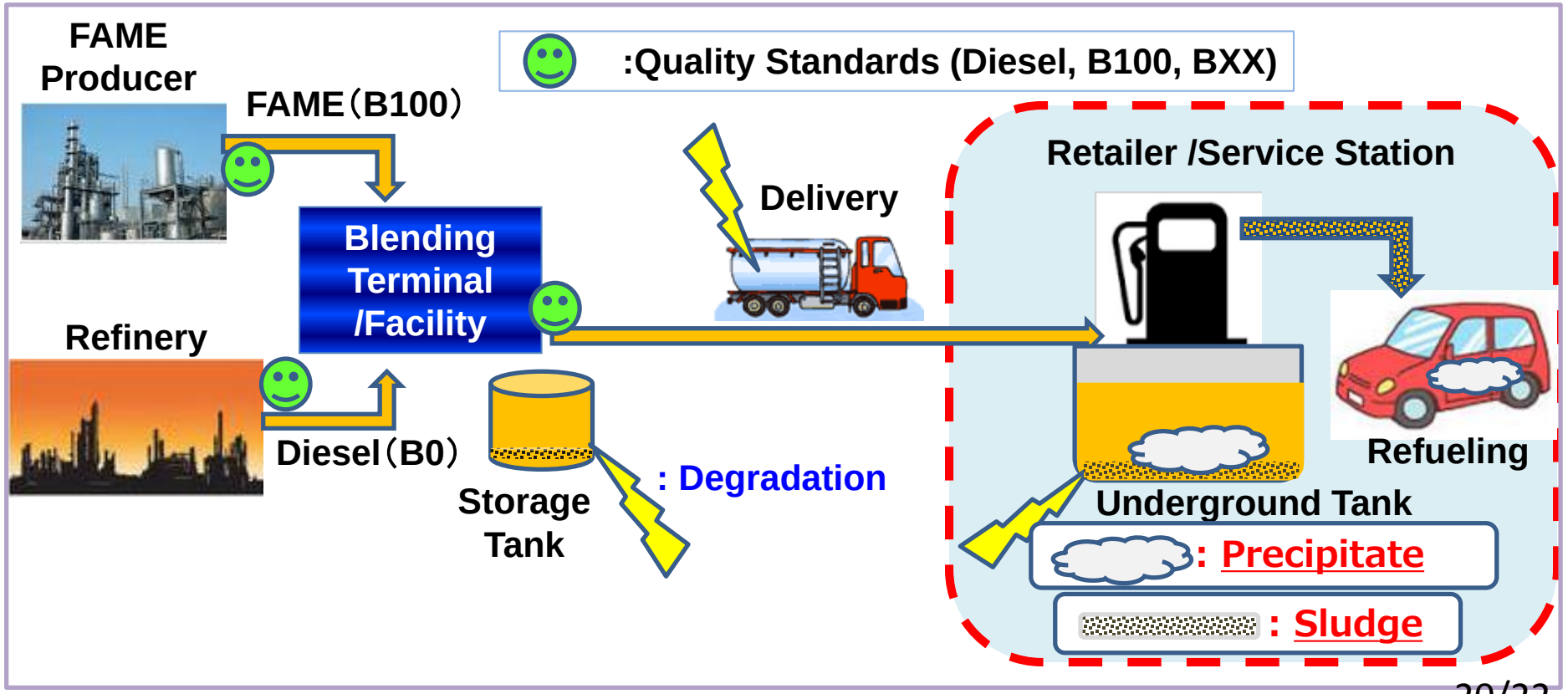
- ✓ Vehicles need to have fuels with expected quality at SS/retailers.
- ✓ Some opportunities to degrade its quality during delivery, handling, and storage process from production facilities to SS.
- ✓ Inspection/monitoring and maintenance process need to be considered entire process after fuels production.



☐ Summary (1/2)

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- The characteristics of FAME is different from conventional diesel fuels and its discrepancy will become large accordingly when FAME content is increased.
- B20 may be acceptable for Euro 2/3/4 compliant vehicles, when all conditions that JAMA recommends are met. However, it is not acceptable to use beyond B20 because of no experience as a general conventional diesel fuel in the market.
- For Euro5/6 compliant vehicles, it is not acceptable to use beyond B7 because the impact of higher FAME blends on new/sophisticated technologies are unknown.

Summary (2/2)

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- It is important to develop fuel standard of B100/Bxx in order to control quality strictly, however, some issues related to distillation and LHV, would remain when consider higher FAME blends.
- There may not be solution for some issues on higher FAME blends, and hydrogenated type of biodiesel may not fix them as well.
- Establishment of quality control system (monitoring system) for the market fuel needs to be considered, because FAME can degrade easily and may create problem on the vehicles.

Thank you very much for your attention

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