

BDF project

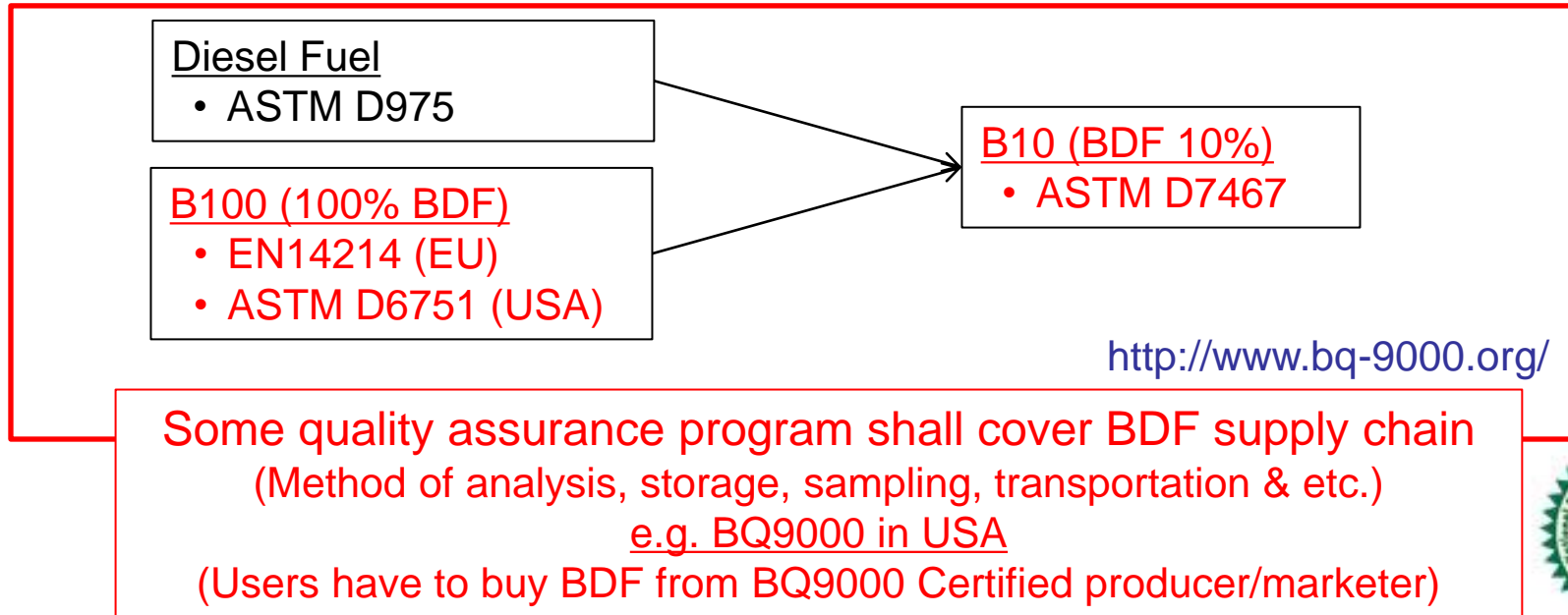
1. Komatsu action with B10 mandate in Indonesia
2. Technical investigation with B20
3. Summary

Global situation of BDF

		2008	2009	2010	2011	2012	2013	2014
Standard	ASTM D7467	B5						
	EN590		B7					
BDF Mandate	Others						Indonesia B5	B10
	USA			B5 Brazil			B5 Massachusetts	B10 Minnesota in Summer
Komatsu Global policy		2007 Recommend (no warranty)					● B5/B7 (2013)	

BDF quality standard for Komatsu warranty

- BDF quality (B100 & blended) shall comply with EN/ASTM standard
- BDF supply chain shall be certified by a quality assurance program



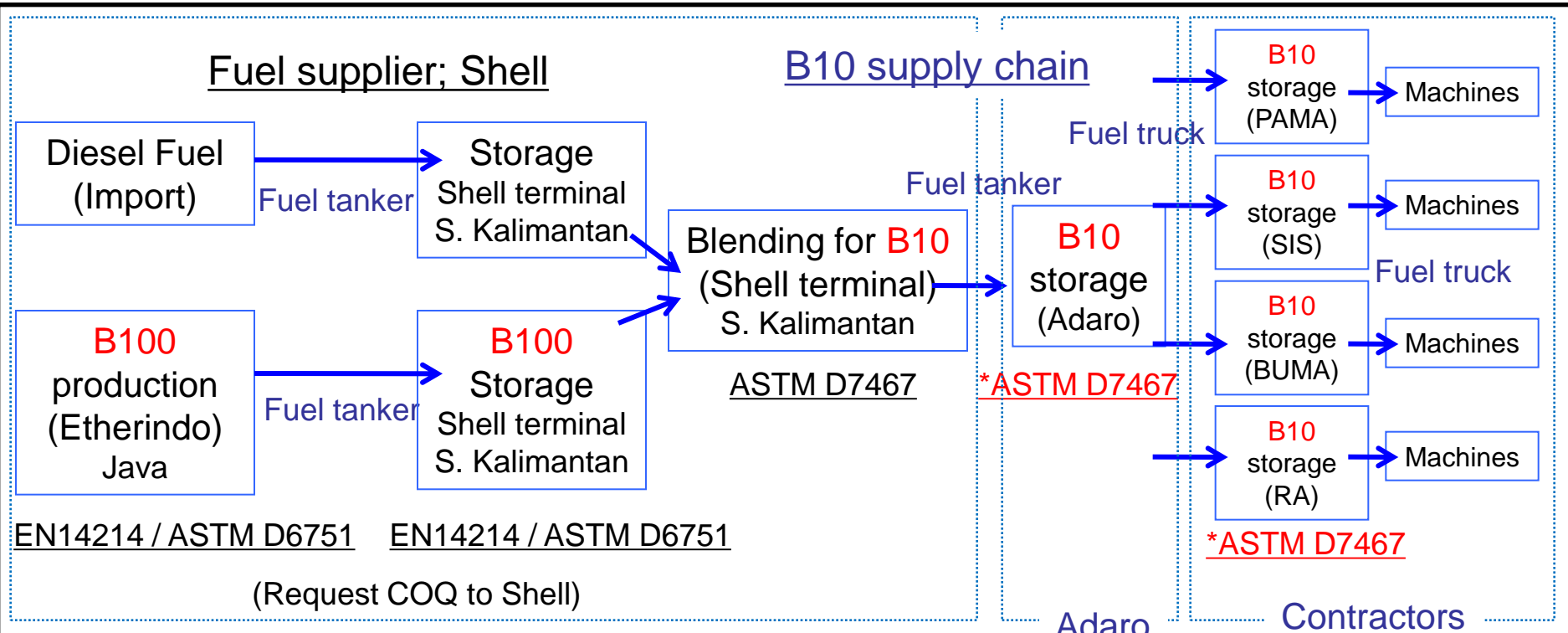
- The Gov. of Indonesia have own Standard SNI 7180 (B100)
- No quality assurance program in Indonesia (no assurance of BDF quality)



- Komatsu warranty policy can not meet BDF situation in Indonesia
 - CAT & Cummins policy is also same as Komatsu

Komatsu supporting B10 Supply Chain management of Adaro

- B10 quality of Adaro B10 supply chain comply with ASTM D7467
- KMSI can prepare warranty of machines with current B10 in Adaro mine

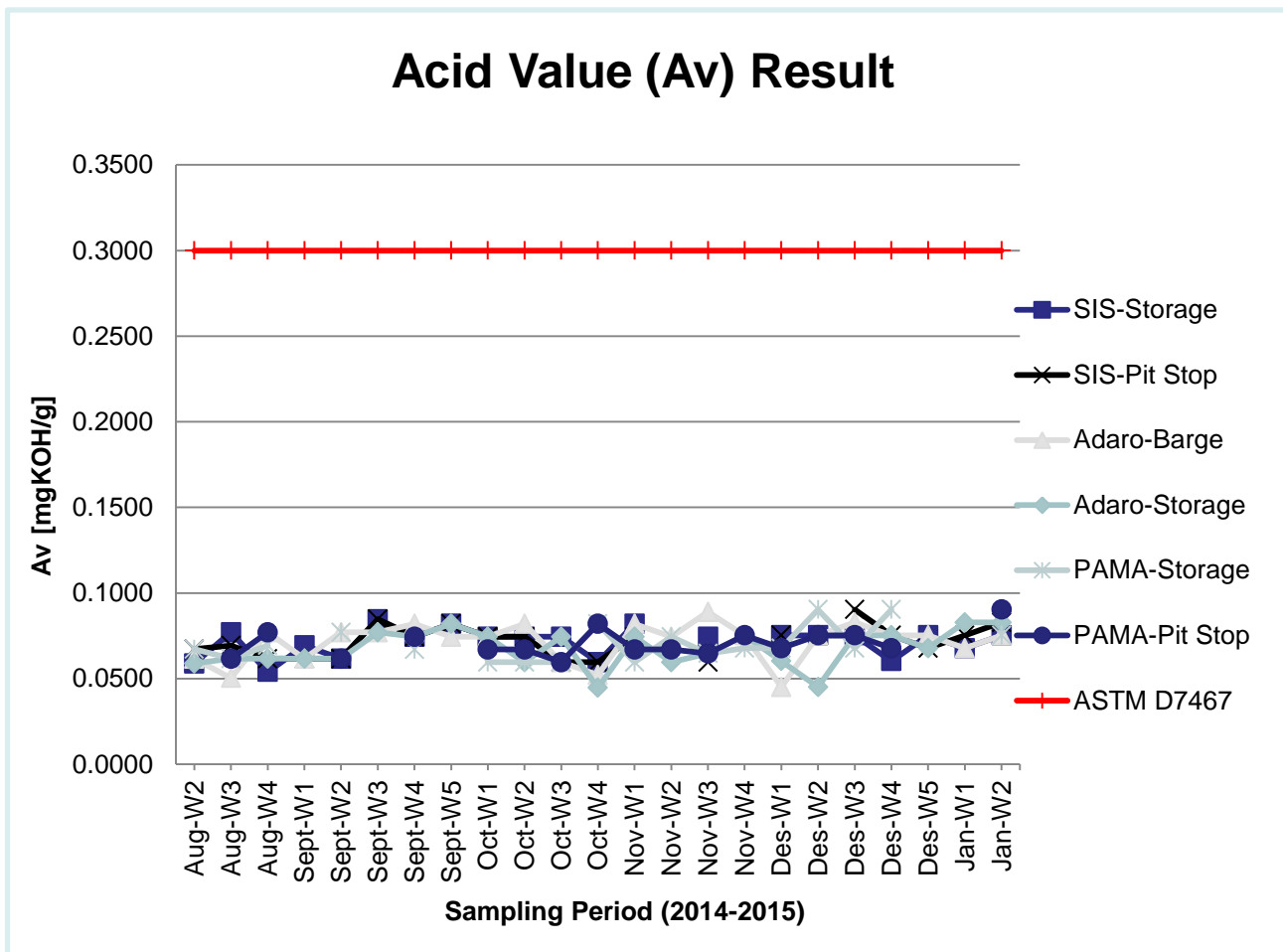


***Analysis once a week in B10 supply chain**

- No quality issue of B10 has been found in B10 supply since Aug. 2014

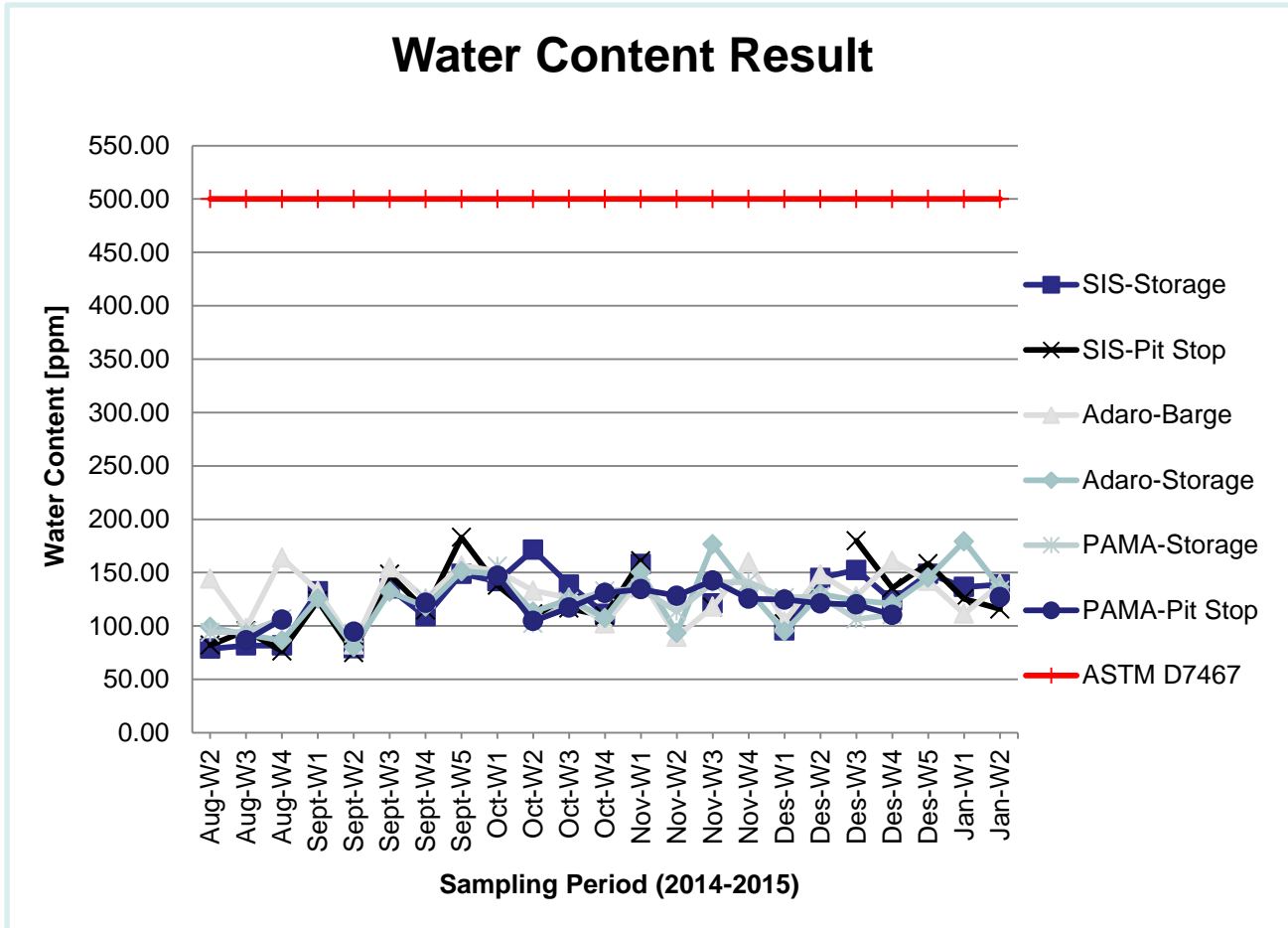


Acid Value (Av)



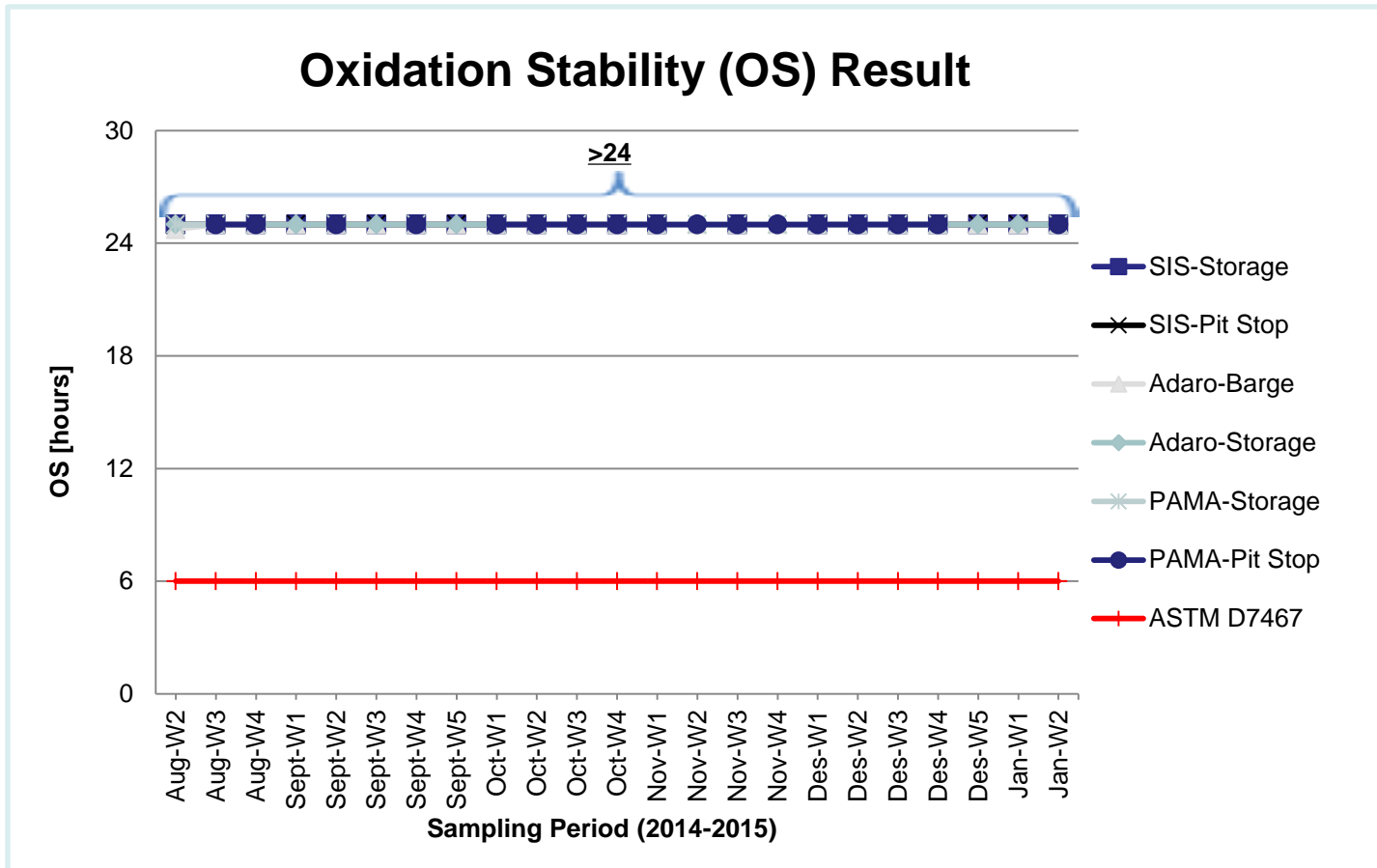
Av Sample < Av Standard in ASTM D7467 : **max 0.3 mg KOH/g**

Water Content



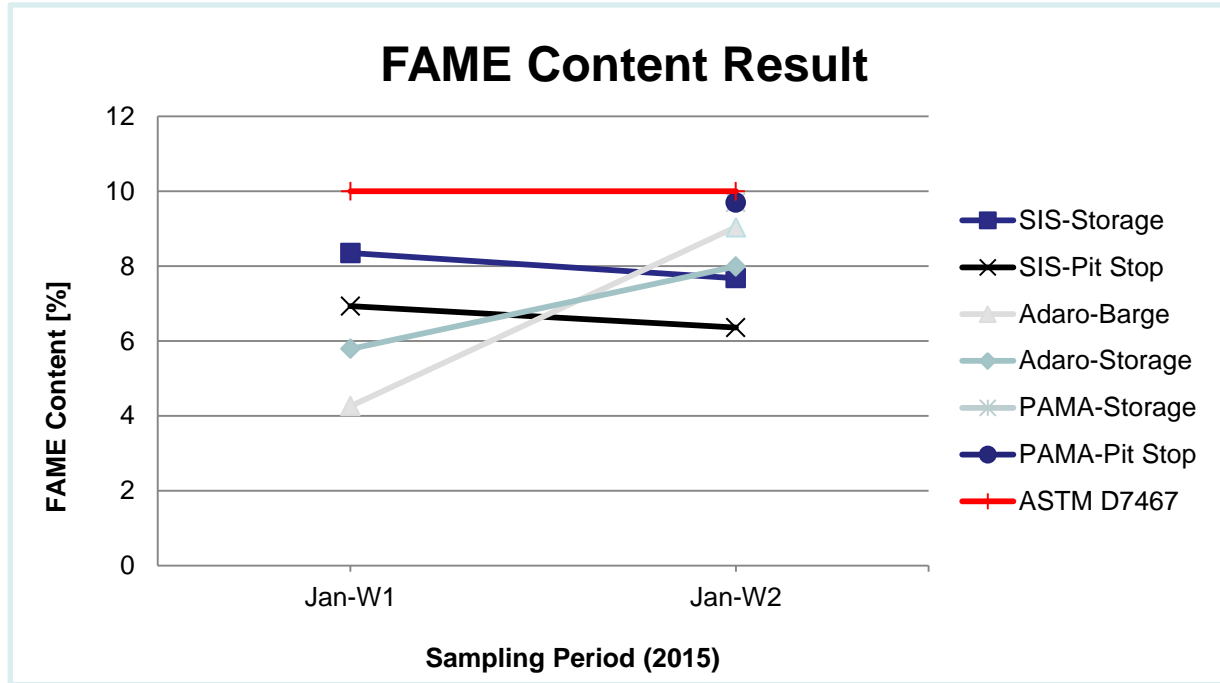
Water Content < Water Content in ASTM D7467 : **max 500 ppm**

Oxidation Stability (OS)



OS < OS in ASTM D7467 : **min. 6 hours**

FAME Content



FAME content is below 10%

*FAME content analysis started from January 2015

BDF

- Project Jatropha BDF
- Commercial Palm BDF
- *Calorie of 100% BDF is app.15% lower than Diesel fuel

Various level of BDF (0%, 5%, 10%, 20%, 50%, 100%)

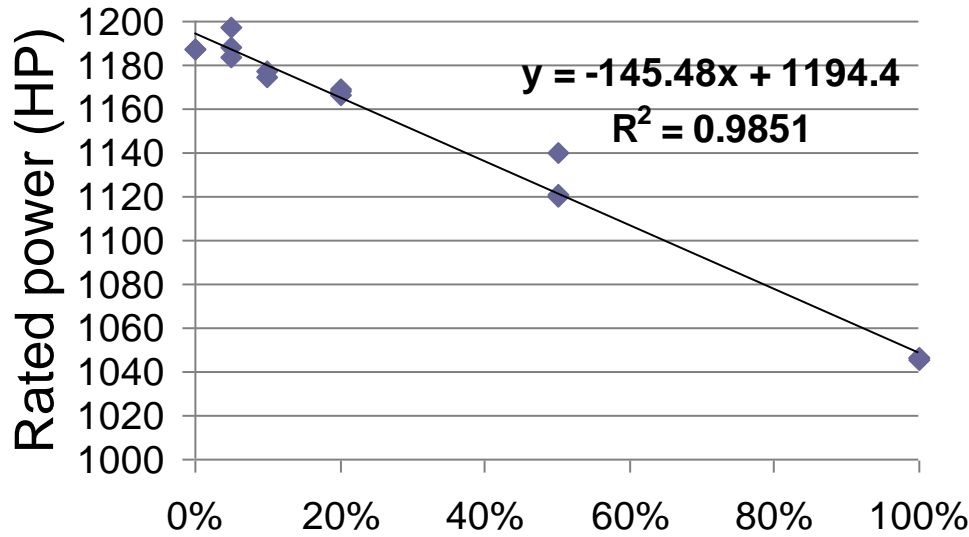
- 3 replication of each level

Data

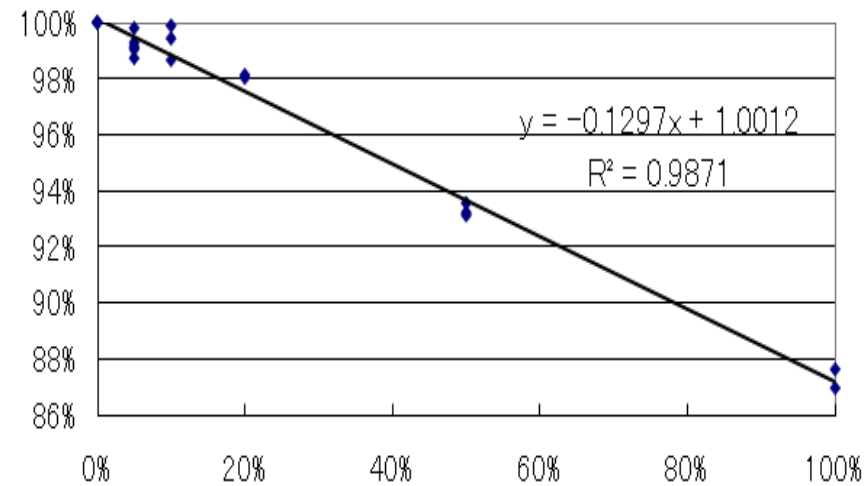
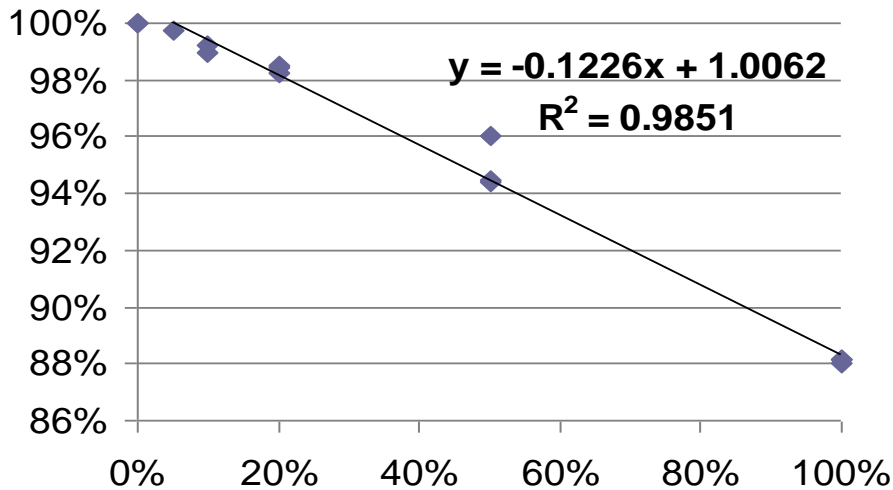
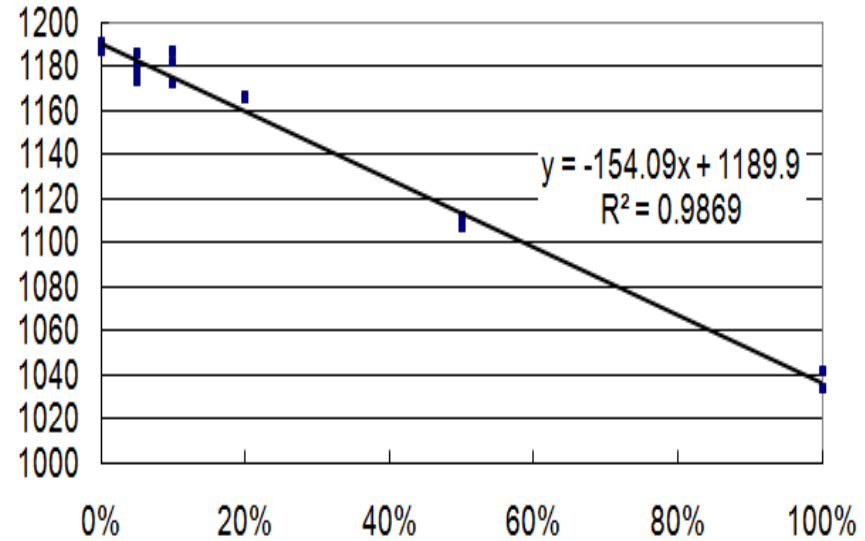
- Rated Output
- Engine Torque Curve



Jatropha BDF (project)
April 2011

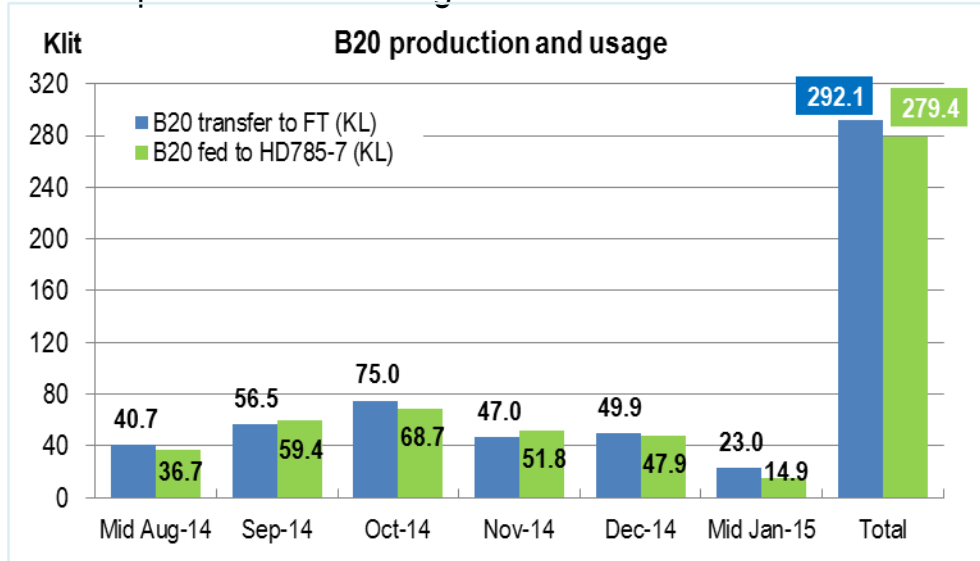


Palm BDF (commercial)
Oct 2010



Confidential to B20 project (ADARO-KOMATSU-UT-SIS)

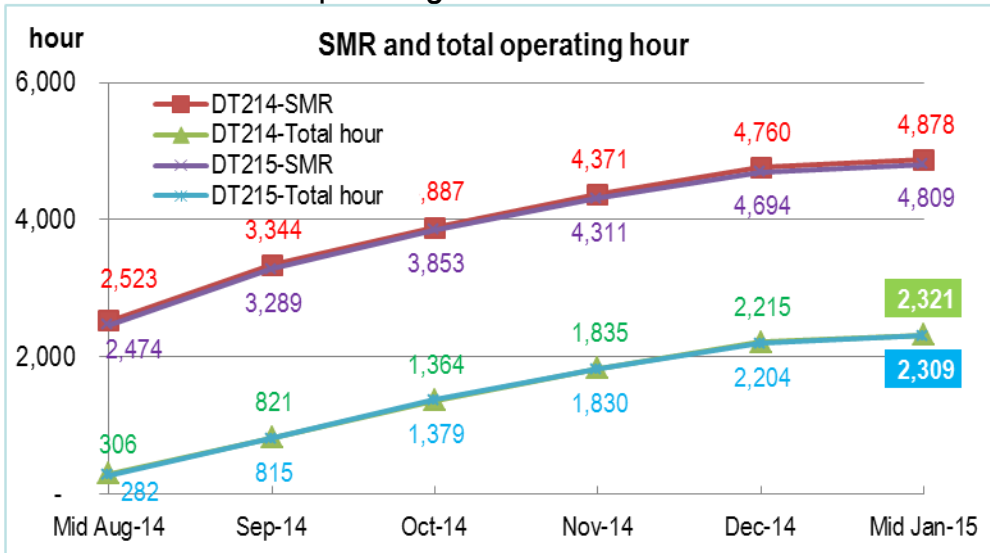
A. B20 production and usage



1. Target;
16,000 hours
2. Method;
2 units HD785 (SIS) with B20 produced by the project B20 = B19 (palm) + B1 (jatropha)
3. Purpose;
Investigate LCC with B20 comparing with diesel fuel (maintenance cost, component life)

B20 production and monthly usage has positive correlation. No abnormality founded. Normal usage of B20

B. SMR and Total operating hours

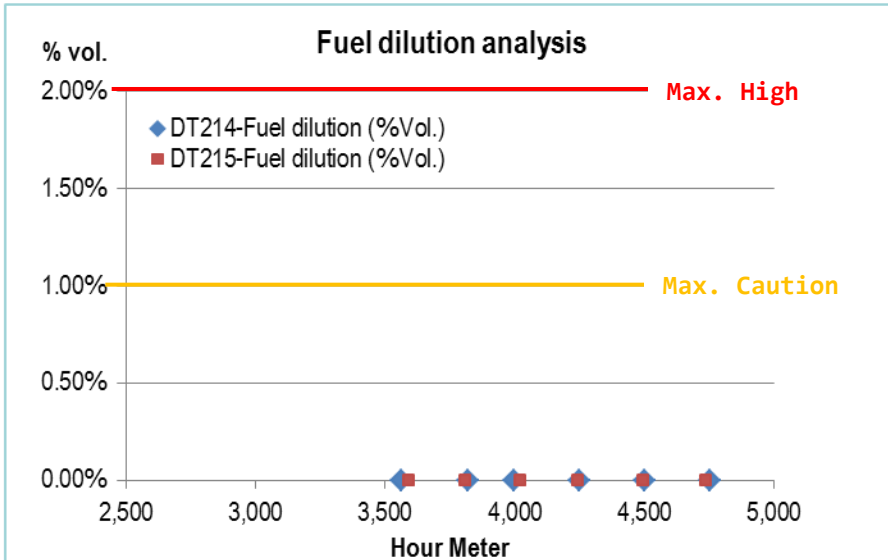
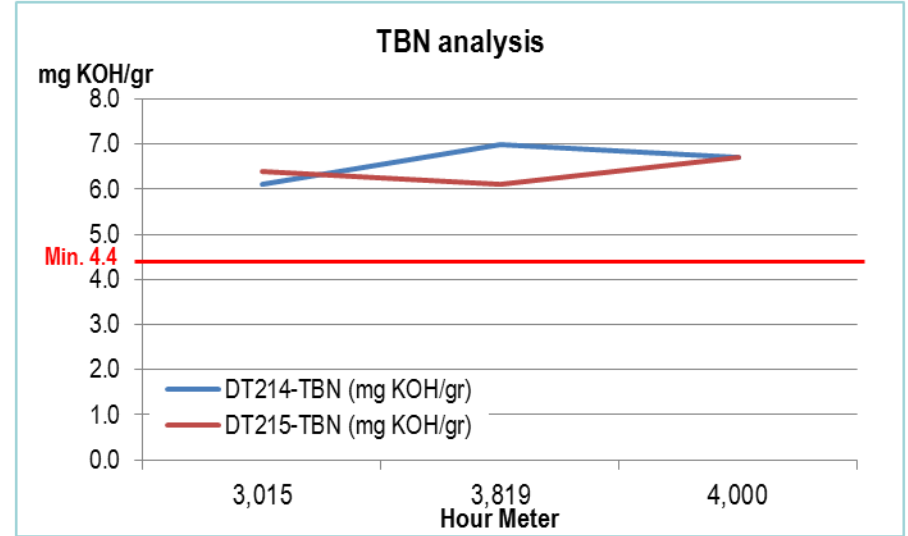
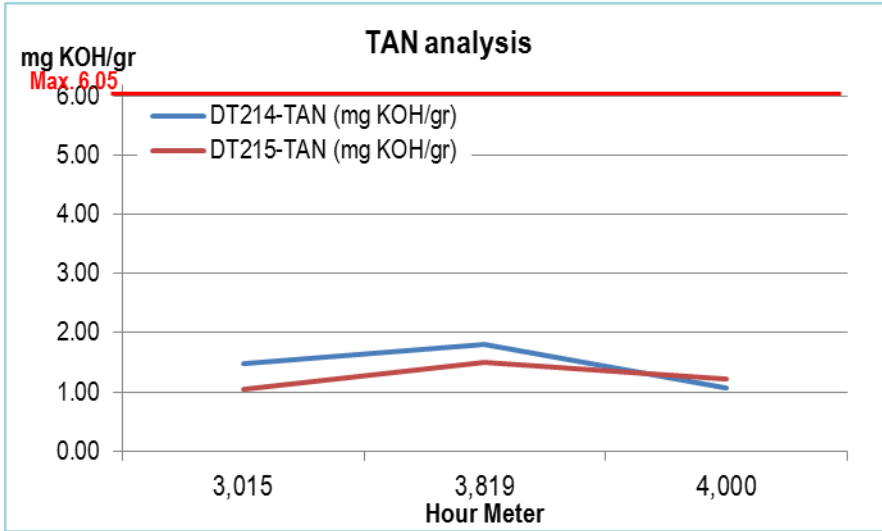


- Mid of Jan'15 total operating hour:
 - DT214 : 2,321 hours
 - DT215 : 2,309 hours
- Rain start occurred in Nov-Jan, expressed in operating hour:
 - Sep : 524hrs
 - Oct : 553hrs
 - Nov : 461hrs
 - Dec : 377hrs
 - Jan : 105hrs (mid), estimated around 200hrs

Confidential to B20 project (ADARO-KOMATSU-UT-SIS)

C. Monitoring

Engine oils analysis (TBN, TAN and Fuel dilution)



Result: TAN, TBN and Fuel dilution values are NORMAL in range every 500 engine oil hours

Result of component test (1)

- B20 causes NBR or CSM degradation

B20 test data

Hose	Zinc	Degraded
NBR Yokohama	Elution	Swelling
NBR BS	Elution	Swelling
CSM*	ND	Swelling

- NBR;
Nitrile rubber
- CSM;
Chlorosulfonated polyethylene rubber
- FKM;
Fluoroelastomers

*The BDF project data of HD785 showed **CSM was better than NBR** in term of degradation

- NBR or CMS hoses shall be changed to FKM to for B20
 - Komatsu will use FKM hoses only for a brand new unit
 - Customers shall change to FKM hoses by themselves

- Zinc causes injector deposit
 - Reduce jet volume

Data of effect of B20 on fuel tank

Material steel sheet	Inside surface processing	BDF effect	Model
Acid cleaned	Cationic electro deposition coat * (should be improved one)	degraded	
Acid cleaned	Epoxy coat (Dengyo)	Safe	
Acid cleaned	Phosphate Zinc coat (parker)	Safe	
Acid cleaned	Anti – Rust only	Safe	
Zinc – coated	Anti – Rust only	Zn elute	

- Investigating if Zinc – coated tank shall be changed for B20
 - More than 30,000 units with Zinc – coated tank in Indonesia

Request to the Government of Indonesia for BDF mandate

1. Improved SNI matching to EN or ASTM
2. Established a guide line or SOP for BDF producers & marketers and authorized the producers & marketers
 - Currently Komatsu can prepare warranty only for Adaro case

Komatsu investigation summary for B20

1. Fuel hoses shall be changed for all models
2. Fuel consumption shall increase in app. 2%
3. Fuel tank material shall be changed for some major models?
(still under investigation)
4. Considered engine oil maintenance period shall be shorten,
500 hours to 250 hours
5. Long term effect is unknown