Heavy Fuel Oil for Marine Engines - Fuel Additive option for Quality Improvement

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Introduction

- Environmental Regulations – Demand for quality Improvement.

- Large Investment in Refineries

- Long Time Frame – 20 to 30 years

- Implied Increase in cost of marine fuels

Bunker Fuel Standards

- ISO 8217
- Deficiencies
    - Fuel Stability
    - Ignition Quality
    - Injector Cleanliness

Operational Problems

- Fuel Instability
  - Sludge
  - Filter Choking
  - Rack Jamming
  - Erratic viscosity control
  - Impact on fuel atomisation
- Test Methods
  - Hot Filtration Test
  - Shell P Value
  - ROFA S Value
  - Turbiscan

Exhaust Valve/Turbocharger Deposits

- Generally Reported - Study CIMAC India
- Causes

  -Ignition Quality

  - CCAI

  - FIA IP 541/06

  - Impact of poor ignition quality

  - Study – Mr. Taheda, Nippon Yuko

  - No correlation between CCAI and FIA results.

  - CCAI > 845, dispersion of ignition delay large

- Investigated relationship between FIA CN and combustion problems
- In all cases of fuel related engine problems, FIA CN was low.

- Recommended criterion for ignition quality - 20 FIA CN minimum

Solutions Recommended – Mr. Taheda

- Adjust Injection Timing
- Add Cetane Improver
    - 2 to 3 Points Improvement.

- Blend with Good Fuel – Stabilise with dispersant additive

- Quality Assurance Programme - Oil Major
    - Stability
    - FIA

- Cetane Improver - To Address Fuel Ignition Quality

Injector Cleanliness

- Cracking Processes in Refining
- Unsaturated HC- Injector Fouling
- Standards in Diesel - XUD 9
- ¼ of all Injectors in marine engines changed earlier than recommended schedule – 4000 hours

NO_x & Soot Emission Reduction

- Finer Spray Orifices
- Higher Injection Pressure
- Higher Cetane Number

- Finer Orifices- More Prone to be affected by fouling
- Detergent/Dispersant for Injector Cleanliness

Requirements for Efficient Operation

- Stable/Homogeneous Fuel
  - Precise Viscosity Control
- Clean Injectors – Good atomisation
- Good Self Ignition Quality
- Complete Combustion
- Benefits:
  - Higher SFC, Reduced Deposits, Lower Maintenance, Lower Noise & Emissions

Multifunctional Additive Solution

- Deficiencies in fuel fuel quality clearly identified
- Negative impact of deificiencies on engine performance evident
- Fuel quality improvement at refinery level not feasible in short term
- Mixing of fuels from different sources unavoidable
- Engine operator has risk of using fuel not completely or optimally fit for engine

TOTAL EMDFA 401

- Product of TOTAL France
- Contains
  - Dispersant to stabilise fuel
  - Detergent dispersant to keep injectors clean
  - Cetane Improver to improve self ignition and smooth combustion quality of fuel
- “Ashless” - completely organic and combustible, no metallic constituents, as required by manufacturers

Approach to evaluate performance

- No standardised engine test methods
- Research engine tests not feasible
- Tests in actual operating engines unavoidable
- Land based marine engines operating as base load power generating units - operate at consistent conditions
  - Evaluation and monitoring possible
  - Reasonable accuracy of data

Trials In India

- Dosage 400 ppm
  - **Clean up 1000 ppm – 250 hours**

-Methodology
  - **250 hours - Without additive – Reference SFC**
  - **250 hours - Clean up at 1000 ppm**
  - **250 hours - Keep clean operation – 400 ppm**

- Consistency of load.
- Unavoidable load fluctuations – exclude deviant data.
- Complete trial in 30/40 days –consistency in climate condition

Engine Makes for Trials with EMDFA 401

- WARTSILA
- B & W MAN
- CATERPILLAR
- PIELSTICK
- SULZER
- NIGATA
- SKODA

SUMMARY OF PERFORMANCE TEST RESULTS ON LAND BASED MARINE ENGINES IN INDIA

NEO PETCON INDIA PVT LTD

Pasupati Fabrics Limited

- **3 X 2700 KVA CATERPILLAR**
- **PRE ADDITIVE** **3.69 kwhr per litre**
- **POST ADDITIVE** **3.77 kwhr per litre**
- **IMPROVEMENT** **2.17 %**
- **REDUCED SLUDGE** **26 % - 40 %**
- **NO INJECTOR DEPOSITS AFTER 4000 HRS OPERATION**
- **REDUCED EXHAUST VALUE & TURBOCHARGERS DEPOSITS**
- **DISCERNIBLE REDUCTION IN EMISSIONS**

SHAMKEN SPINNERS LTD.

- 1 x 2700 KVA CATELPILLAR
- SERIOUS PROBLEM OF RACK JAMMING WHICH NECESSITATED EMERGENCY SHUTDOWN
- EMDFA 401 APPLICATION
    - RACK JAMMING PROBLEM ELIMINATED
    - 2 % SFC IMPROVEMENT
    - REDUCED SMOKE

SHAH ALLOYS LTD., AHMEDABAD

- **8 ENGINES, TOTAL CAPACITY ~ 45 MW, SULZER,PIELSTICK**
- **SFC IMPROVEMENT - 1.9 % TO 2.4 % in different engines**
- **SIGNIFICANT REDUCTION IN MAINTENANCE COSTS & EFFORTS**
  - **MUCH CLEANER INJECTORS, ENHANCED INJECTOR LIFE**
  - **LOWER DEPOSITS ON**
    - PISTON CROWN
    - EXHAUST VALVES
    - TURBO CHARGERS
    - MAJOR OVERHAUL CYCLE ENHANCED FROM 8000 TO 12000 HOURS.

YKK INDIA PVT. LTD., BAWAL, HARYANA

- **1 X 2.5 MW, WARTSILA ENGINE**
- **SFC IMPROVEMENT 2 % PLUS**
- **OTHER CUSTOMER OBSERVATIONS**
  - **HEALTHIER ENGINE SOUND**
  - **LESS SMOKE AT START UP**
  - **CLEANER INJECTORS**
  - **CLEANER TURBOCHARGER**
  - **REDUCED FILTER CHOKING**
- **12000 HOUR OVERHAUL REPORT**

ASAHI GLASS INDIA LTD., BAWAL, HARYANA

- 2 X 3.6 MW, 1 X 1.8 MW, B& W MAN ENGINES
- SEPARATE TRIALS ON THE TWO 3.6 MW
- SFC IMPROVEMENT 2% PLUS IN BOTH CASES
- RACK JAMMING PROBLEM ON START UP ELIMINATED
- ENGINES UNDER O & M CONTRACT WITH POWERICA. POWERICA'S FEED BACK TO CUSTOMER HAS BEEN VERY POSITIVE
- INCREASED OVERHAUL PERIOD FROM 16000 HRS TO 18500 HRS

VVNL YELAHANKA, BANGALORE

- 6 X 20 mw Pielstick
  - Over 6% Improvement in SFC
  - Erratic viscosity control problem eliminited
  - Filter choking eliminated
  - Drastic smoke reduction

OTHERS

- **Star Wire Industries Ltd 2.2 mw Pielstick**
  - **Over 5% improvement in SFC**
- **Mangalam Cenents 5.5 mw Nigata**
  - **4% improvement in SFC**
- **Surya Roshni Ltd., Bahadurgarh1450 kw Skoda**
  - **4.4% Improvement in SFC**
- **Jindal Industries Ltd., Hissar 2mw Pielstick**
  - **2.5% Improvement in SFC**
  - **Drastic reduction in engine deposits**
- **SPL Ltd., Bahadurgarh, 4.5 mw Sulzer**
  - **3% improvement in SFC**
- **Magnum Power, Manesar, 6.5mw Deutz**
  - **over 3% improvement in SFC**

Benefits

- **SFC Improvement – at least 2%**
- **Longer Injector Life**
- **Longer life of exhaust valves & turbo charger components – drastic reduction in deposits**
- **Increase in periods between overhauls**
  - **Case 1 – 8000 hours to 12000 hours YKK Wartsila**
  - **Case 2 -16000 hours to 18500 hours Asahi B&W MAN**
- **Sludge reduction – from 1% to less than 0.5%**
- **No Filter Choking/Rack Jamming**
- **Less Noise/Emissions –Qualitatively observed**

Issues During Trials

- Changes in Fuel Quality
- Climate Changes
- Instrument Errors - recalibration and retrial

Conclusion

- Deterioration of Fuel Quality Inevitable Reality
- Deficiencies Identified
- Impact on Engine Performance studied well

- Well Designed MFA optimum cost effective solution

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