Framework: Scope and aims: This course is intended to address the following scope:

Modern Diesel Engine Combustion Engineering.

This Course target senior students, but not limited to.

Its main aims are to: Prepare the students for troubleshooting of any combustion/compression issues that can arise from poor combustion performance, poor maintenance activities and poor fuel quality.

It does this by: Lecture and combustion analyzer lab work. Successful completion of the course enables the students who successfully completes this course will be able to:

a) The Ability to understand basic to more in-depth combustion processes in a diesel engine

b) The Ability to analyze specific combustion problems using cutting edge software

c) The Ability to understand why the compression pressure is the most important piece of information in an engineer's determination of poor performance, how to isolate a specific problem using the "Pedersen Combustion Matrix"

d) The Ability to understand how poor combustion affects the T/C performance and what are the vital signs?

e) The Ability to use the analyzer with the software as a prediction tool

f) The Ability to use the analyzer with the software to move from Time Based Maintenance (TBM) to Condition Based Maintenance (CBM)

g) The Ability to understand MARPOL Annex 6: How the engines performance and parts can influence the Annex 5 requirements, (NOx, SOX and Particulate matters)

h) The Ability to create an Engine Combustion Health report

This combustion matrix will be used and shared with students. Is is much larger then seen here.

Pedersen's Combustion Fault Finding Matrix with Fuel Injection Equipment.

4-STROKE MEDIUM SPEED ENGINE	PMAX HIGH	MIP LOW	MIP HIGH	TEXH HIGH All Cylinders	TEXH HIGH Single Cylinder	TEXH LOW	EARLY INJECTION	LATE INJECTION	REDUCED INJECTION PERIOD	INCREASED INJECTION PERIOD	INJECTOR NOSSLE TIP BUILD UP	PRE-IGNITION	RAPID IGNITION	IGNITION KNOCK (DELAYED IGNITION)	DARK EXHAUST FUMES/PARTICULATES	WHITE/GREY SMOKE	SCAV. TEMP HIGH
Leaking exhaust valve, blocked inlet valves		x		x	x										x		
Defective or worn piston rings, piston or liner		x		x	x												
Fuel pump index low		x				x											
Partially choked indicator cock		x															
Fouled T/C Nossle ring	x			x												x?	
Dirty or damaged turbine/ compressor		x		x		x									x		
Fouled air filter				x											x		
Fouled air cooler (airside)				x								x?	x?		x		
Fouled air cooler (waterside)				x									x				x

The following is part of the classes

Chapter 1:

Combustion problems:

The most common cause for Combustion problems, or, as

some choose to call it: Poor Firing, can normally be traced back to the following

groups:

- **Fuel injection equipment**
  - Fuel valve, with its various parts.
  - Fuel pump, High Pressure, with its various parts.
  - Camshaft, chain arrangement, timing
- **Viscosity regulating equipment**
  - Viscometer, malfunctioning or out of calibration equipment.
  - Temperature regulating equipment, , malfunctioning or out of calibration equipment

- **Fuel oil filtration and Purification plant**

  - Fuel oil filters, both manual and automatic filters
  - Fuel pump, High Pressure, with its various parts.

- **Poor Bunker quality**

  - Poor bunker quality delivered to vessel, and inadequate actions taken by vessel staff to reduce or eliminate damage to the diesel engines injection and combustion parts.
  - Poor handling of fuel onboard, such as mixing with non-compatible fuels, improper storing conditions, poor purification and filtrations.

- **Air and air cooler system**

  - Scavenging ports/intake valves
  - Scavenging air receiver.
  - Air cooler

- **Turbocharger system**

  - Turbocharger with exhaust gas manifold

- **Exhaust gas system, engine**

  - Exhaust valve
  - Hydraulic pump/actuator system for exhaust valve
  - Camshaft, chain arrangement, timing

- **Engines internal parts**

  - Piston, piston rings.
  - Cylinder liner, cylinder lubrication

- Main bearings, crosshead bearings, connecting rod bearings, thrust guides and thrust bearings.

All of these factors, either as a single element or series of various elements, the latter in most cases is the reality, has an impact on any diesel engine's total overall performance.

It can be said in one simple sentence: If overall performance is good, and as close to baseline/sea trail data as possible, the fuel consumption will be within the specification from engine builder.

But, as this document will prove, the Bunker consumption can increase slightly or dramatically, depending on what the scenario is, either failure from fuel injection system with its associated equipment, poor balancing of engine, poor bunker quality or incorrect/improper treatment of the fuel oil itself. That is either in storage or during consumption.

Chapter 2:

Engine reduced performance evaluations:

- **Fuel injection equipment**

  - Fuel valve: In general, there are 6 usual failures of the fuel valve which gives poor atomization, and they are:

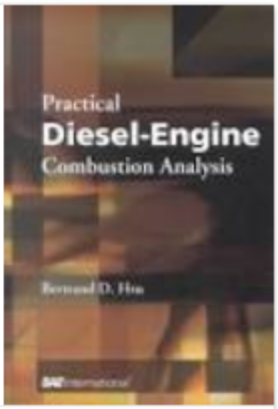
a. Injector dripping (not sealing properly)
   - Early ignition, rapid combustion
   - Increased exhaust gas temperature
   - Increased thermal load on liner and piston crown

b. Incorrect setting of the Injector lifting pressure (opening pressure), either to high or to low
   - Low spring setting will result in fuel valve opening earlier and stop of injection too late, resulting in course droplets.

c. Injector holes to large (worn out) producing larger droplets as calculated for
d. Spindle Guide not working properly
e. Clogging of injector nozzle,
f. which results in higher injection opening pressure, resulting in later ignition

Practical Diesel-engine Combustion Analysis

Book by Bertrand D. Hsu



Did you like this book?

This book examines some basic characteristics of diesel engine combustion process, and describes the commonly used tool to analyze combustion - heat release analysis. ... Google Books

Originally published: 2002

Author: Bertrand D. Hsu

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