

Lecture 18
3rd Semester M Tech. Mechanical Systems Design
Mechanical Engineering Department
Subject: Advanced Engine Design
I/C Prof M Marouf Wani

Lecture 18 – Alternative Fuels in I C Engines

Topic: Ethanol - 28-10-2020

Alternative fuels for SI and CI engines

Alternative fuels in SI engines:

- Gasoline.
- Compressed natural gas (CNG)
- Liquefied petroleum gas (LPG)
- Ethanol-gasoline blends
- Methanol-gasoline blends.
- Hydrogen.

Alternative fuels in CI engines:

- Diesel.
- Bio-diesel.
- CNG substitution in diesel.
- Ethanol-diesel blends

Ethanol:

- Ethanol has long been considered a good spark ignition engine fuel , and engines were run on ethanol very early in engine development.
- Ethanol can be used as a fuel because of its good combustion properties and because of its potential “self sufficiency” , it can be produced by the agricultural sector which would satisfy their needs and sell the excess to others.

Sources of ethanol:

- Corn, Potatoes, Beets, Sugarcane, Grapes, Almost any source of starch or sugar.

Vehicle performance and emissions characteristics.

- The primary emission advantage of using ethanol blends is that co emissions are reduced through the “blend leaning” effect that is caused by the oxygen content of ethanol. The oxygen in the fuel contributes to combustion much the same as adding additional air.
- The NO_x emissions are slightly higher.

- Fuel efficiency in energy terms should be the same or slightly better when using ethanol-gasoline blends. Ethanol-gasoline blends through the use of increased compression ratio should have even higher performance, greater fuel efficiency, or a combination of both, depending on calibration of the engine control system.

Countries where ethanol is used as I C Engine fuel:

- Brazil, U.S.A

Indian scenario:

- Till recently the gasoline sold in Indian market has 5%-10% ethanol as its essential constituent which is scheduled to be increased to 10% from November 2008. This has been done to conserve petroleum and save foreign exchange.

Comparison of Physico-chemical properties of ethanol and gasoline

- Formula
 - Ethanol ----- C_2H_5OH
 - Gasoline ---- C_4 TO C_{12}
- Molecular weight
 - Ethanol -----46.07
 - Gasoline -----100-105
- Composition by weight
 - Ethanol -----carbon---52.2%
 - -----hydrogen---13.1%
 - -----oxygen---34.7%
 - Gasoline -----carbon ---85-88%
 - -----hydrogen---12-15%
 - -----oxygen-----0-4%
- Lower heating value, MJ/L
 - Ethanol -----21.1
 - Gasoline -----30-33
- Stoichiometric air-fuel ratio, weight, kg/kg
 - Ethanol -----9.00
 - Gasoline -----14.7
- Octane number research
 - Ethanol -----108
 - Gasoline -----88-100

- Octane number motor
- Ethanol -----89.7
- Gasoline -----80-90

Materials compatibility:

- The metals recommended for use with ethanol include: carbon steel , stainless steel and bronze.
Metals such as magnesium , zinc castings , brass , and copper are not recommended.
Aluminium can be used **if ethanol is very pure** , otherwise it should be nickel-plated or suitably protected from corrosion by another means.
- Ethanol produced for fuel purposes in the past has contained up to **5 volume percent water** and ion concentrations that made it much more **corrosive** than pure ethanol. For an ethanol with these corrosion characteristics , it was found that aluminium and steel could be coated with cadmium , hard chromium , nickel , or anodized aluminium to make them compatible.
- Ethanol is much less aggressive to elastomers.
- Most common elastomers will work satisfactorily with ethanol including buna-n , viton , fluorosilicones , neoprene and natural rubber. Teflon and nylon are compatible and work well with ethanol. Threaded pipe connections are best sealed by using teflon tape.
- The lubricating oil additive package should be tailored to be compatible with ethanol to prevent leaching of the additives from the oil.

Dated: 28-10-2020

Prof M Marouf Wani

I/C Advanced Engine Design
Mechanical Engineering Department
National Institute of Technology
Srinagar, J&K
India – 190006

Text Book:

Alternative Fuels Guide Book
Author - Richard Bechtold
Published By: SAE International USA