

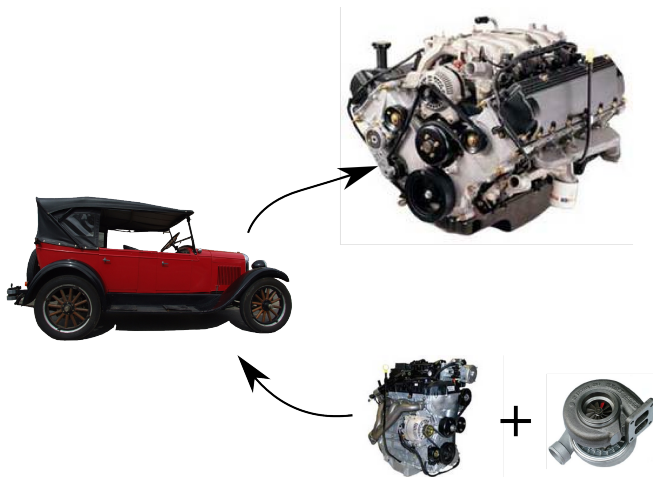
# Limits of Engine Downsizing for Reduced Fuel Consumption

Orian Welling

Fluids, Energy and Turbo Expo  
July 21, 2011



# Engine Downsizing



# Fuel Consumption Map

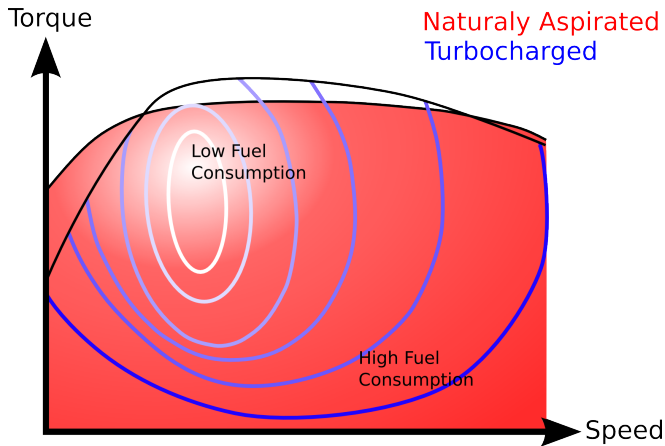


Figure: Fuel consumption maps for a naturally aspirated engine and an equivalently powered downsized engine

# Megaknock

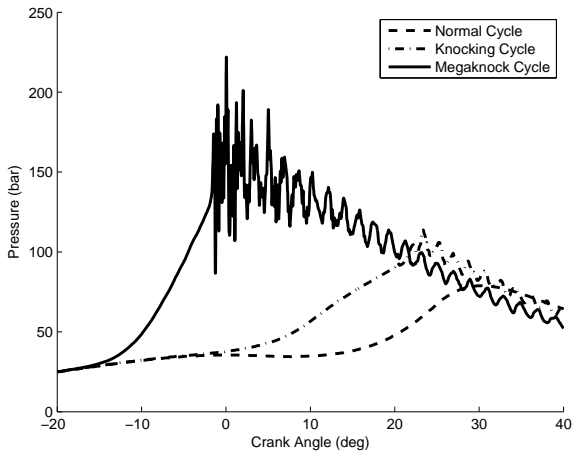


Figure: G.T. Kalghatgi 2009

# Causes of Preignition

- ▶ Plausible Mechanisms
  - ▶ Auto-ignition of oil droplets or vapour
  - ▶ Auto-ignition of oil-fuel mixture
  - ▶ Hot particles
- ▶ Contributing Factors
  - ▶ Variation of residual burned gas and EGR levels and temperatures
  - ▶ Injector spray angle/pattern
  - ▶ Oil Type

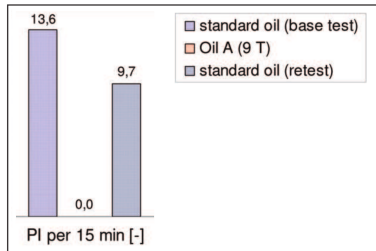


Figure: Pre-ignitions for regular and low ash polyalphaolefine base oils (A. Zahdeh 2008)

# Causes of Preignition

- ▶ Plausible Mechanisms
  - ▶ Auto-ignition of oil droplets or vapour
  - ▶ Auto-ignition of oil-fuel mixture
  - ▶ Hot particles
- ▶ Contributing Factors
  - ▶ Variation of residual burned gas and EGR levels and temperatures
  - ▶ Injector spray angle/pattern
  - ▶ Oil Type



# Engine Test Cell



# Contaminant Testing

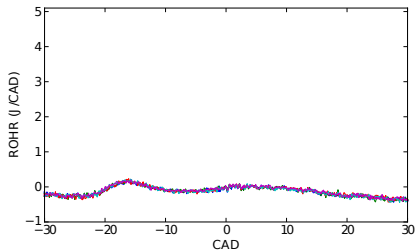


Figure: Contaminant A, 2.9J total

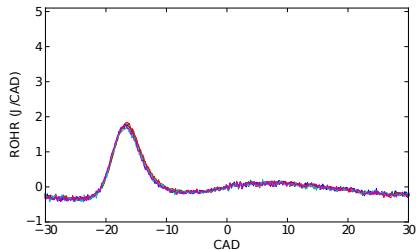


Figure: Contaminant B, 16.5J total



# Questions?