

# Microemulsion as Alternative fuel "Water-diesel fuel"



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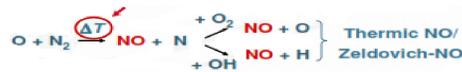
## Abstract:

Microemulsions are macroscopically isotropic mixtures of at least a hydrophilic, a hydrophobic and an amphiphilic component. one possibility for the simultaneous improvement of combustion efficiency and reduction of emission of noxious substances is the use of special fuels, especially fuels which consist of a mixture of aqueous and non-aqueous phases. The water molecules solubilized in the interior of the water pool have properties different from those of bulk water. This makes reverse microemulsions applicable to many fields such as fuels. Water incorporated in fuel vaporizes during combustion and acts as a heat sink; it is also expected to assist in fuel atomization due to microexplosions phenomenon, which occurs during the evaporation of the water inside droplets of fuel. This lowers the peak combustion temperatures, which results in a drastic reduction in nitrogen oxides (NOx) emissions, reduces the particulate soot formation and improves the combustion efficiency. in our work Bicontinuous and water in diesel microemulsions were formulated using single nonionic alkyl poly glycol ethers combined with hydrophilic alcohol ethoxylates. Combustion experiment was done.

### Effect of water on nitrogen oxides (NOx):

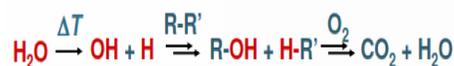
Excess heat vaporizes water, this lowers combustion temperature, and less thermal energy for this initial step available.

→ a decrease of (30%) of nitrogen oxides produced according to Zeldovich equation(2):



### Effect of water on soot:

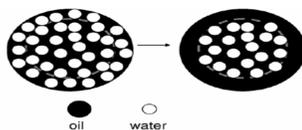
High combustion temperature splits water degradation of fuel molecules to form short chain alcohol and hydrocarbons.



### Microexplosion phenomenon:

Microexplosion It is a general phenomenon that in order to make systems of a lower-boiling liquid immersed as droplets in a higher-boiling liquid, "explode" one must reach a temperature far above that of the lower-boiling component.

→ helps in the atomization of the fuel (how?)



## Result and Discussion:

### i-Our experiments:

o Bicontinuous and water in diesel microemulsions were formulated using single nonionic alkyl poly glycol ethers combined with hydrophilic alcohol ethoxylates.

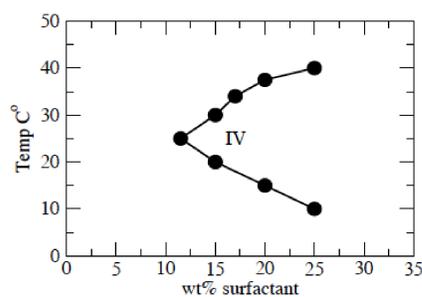


Fig.1.Phase diagram of water-diesel-C11E3 at water to diesel wt. ratio of 1:1 with C16-18 E140 at  $\delta = 0.10$

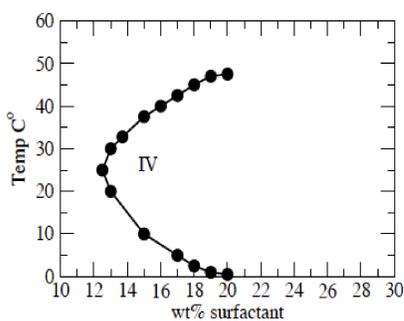


Fig.2.Phase diagram of water-diesel-C11E3 at water to diesel wt. ratio of 1:9 with C16-18 E140 at  $\delta = 0.10$

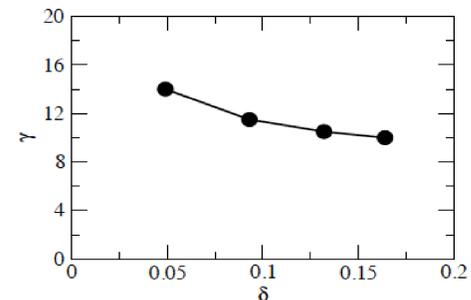
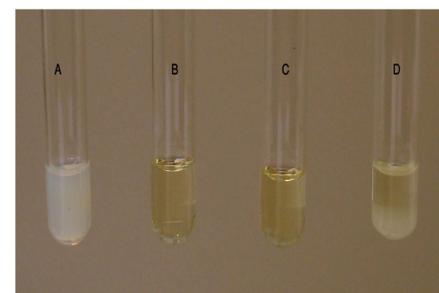
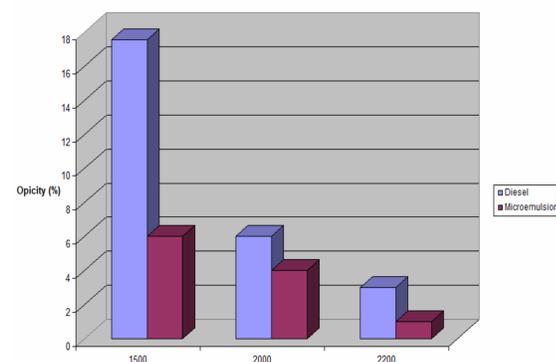


Fig.3.Reduction of minimum amounts of surfactant, needed for solubilizing 10 wt. % of water in diesel by adding the co-surfactant C16-18 E140

Photos for samples representing bicontinuous microemulsion (A), water in diesel microemulsion (B), 100% diesel (C), and a two phase mixture in the absence of the co-surfactant (D).



### Preliminary result of Combustion experiment:



### oii-Our experiments:

o currently water in diesel microemulsions is being formulated using single nonionic sugar-ester surfactant (L1695) combined with 1-pentanol .



## Conclusion:

o Use of microemulsion water-diesel fuel minimum pollutant emissions and improved combustion efficiency.

o microemulsion water-diesel fuel a route which has not yet received the Attention it deserves.

o Use of alternative fuels is no longer a matter for the future; it is a realistic issue of the present.

## Introduction:

**Alternative fuel:** A fuel can be use instead of conventional fuel.

### Why alternative fuel?????

• Synthetic fuels were of prime interest in the 1970s, due to a sudden shortage of petroleum supply kindled by an oil embargo in 1973.

• to reduce emissions of air pollutants.

• Concerns of global warming via greenhouse gases.

### What is the problem ????????

• The problem is incomplete combustion.

• The long-chain hydrocarbons used as diesel fuel do not burn as easily as the lighter ones found in petrol.

Some of the carbon therefore ends up as soot, rather than carbon dioxide, and oxygen that should be combining with carbon combines with nitrogen from the air instead.



### Water-in-diesel emulsions:

The emulsion fuel → an emulsion of water in standard diesel fuel with specific additives, surfactants, to stabilize the system.

The surfactants used, must burn readily without soot formation and should *not* contain sulphur and nitrogen. Thus, they should contain only carbon, hydrogen and oxygen and they should preferably not have aromatic rings in their structure.

Unfortunately, emulsions do not exhibit long-term stability as they separate into an aqueous and an oily phase after a certain time.

### Water-in-diesel microemulsions:

Microemulsions are alternatives to emulsions as a means to incorporate water in a fuel.

Microemulsion-based fuel formulations date back to 1976 when Gillberg and Friberg published a paper on the use of water in-diesel microemulsions as fuel.

o An important aspect is that diesel emulsions and micro- emulsion can be used without engine modifications.

### The advantages of microemulsion-based fuels over emulsion:

o reduces emission of smokes, soot formation in the range (20-60%) and reduce level of nitrogen oxides (NOx) and carbon monoxide CO (10-50%).

o increasing the octane number diesel.

o An important criterion for a microemulsion to be used as fuel is that the one-phase region extends over a wide temperature range.

o The presence of water- diesel fuel improves air- fuel contact and increase the flash point .



Unless the wide range of advantages a microemulsion formulation requires considerably more surfactant than an emulsion.

(the commercial water in-diesel fuels are all emulsions)

## References:

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