CHAPTER V

SUMMARY & CONCLUSIONS

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Three sets of Oxygenated gasoline blends, were formulated using ether oxygenates and three refinery streams . The employed oxygenates were : methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE), and tertiary amyl methyl ether (TAME) Reformate, isomerate, light and heavy naphtha's were the used refinery components.

In the first set, two refinery streams, namely, reformate and isomerate, were used for the formulation of four all-hydrocarbon gasoline blends as reference samples (1RS-4RS) . The formulated hydrocarbon blends were Oxygenated by the addition of 11.0 or 15.0 volume percent of MTBE which are equivalent to 2.0 or 2.7 weight percent oxygen, respectively . Similarly, ETBE- and TAME-blended oxygenated fuels were formulated by the addition of 12.7 or 17.2 volume percent of these ethers to achieve the same oxygen level, In this set of experiments, 36 of oxygenated test fuels were formulated aiming at understanding how gasoline reformulation can alter the performance characteristics of these oxy-fuels, particularly, volatility, octane number and driveability index as compared with the reference hydrocarbon blends .

In the second set, three refinery streams, namely, reformate and isomerate, and light naphtha's, were used for the formulation of 12 oxygenated test fuel blends . Formulation starts with the all-hydrocarbon blends as reference samples (5RS) which was prepared volumetrically from 56% reformate, 34% isomerate and 10%, light naphtha . Oxygenated fuels blended with 4, 6, 8, 11 and 15% of MTBE contain 96, 94, 89 and 85% of all- hydrocarbon reference sample (5RS). Similarly, ETBE- and TAME-blended test

fuels were formulated . This set of formulated test fuels, 10 liters each, were used to study the influence of fuel oxygen level on reducing CO, HC and NO_x in tailpipe exhaust emission using a test vehicle, sahin Type1.4S, Model 2001, 4Cylinders and engine capacity 1400 c.c. The effect of added ether oxygenates on volatility of the oxy-fuels, was also studied and a relation was developed .

In the third set, four refinery streams including reformate, isomerate, light and heavy naphtha's, were employed to formulate two different non-oxygenated reference blends (6RS-7RS) along with 8 oxygenated test fuels . In this set of experiments, the major hydrocarbon portion which constitutes 70-77 vol.% of the formulated blends, was kept unchanged, whereas, the minor portion of naphtha's was slightly altered to balance oxygenate addition .

The obtained results reveal that volatility and the other distillation characteristics depend on the employed refinery streams and their chemical compositions as gasoline components- Blending of ether oxygenate leads to alterations in the compositions of all-hydrocarbon gasoline which subsequently alter the performance characteristics of the formulated oxy-fuels volatility reduction in these oxygenated gasolines is mainly attributed to the amount of added oxygenate . A linear relation is obtained relating volatility reduction and volume percent of added oxygenates . At the maximum permitted oxygen level (2.7wt.%), any of the employed ether contribute up to 3.0 octane numbers to the reference hydrocarbon blends . Calculated driveability index (DI) data indicate that oxygenated gasolines having 1.0-2.7wt.% oxygen contents, gave DI values within those specified by the ASTM standards .

Blending of ether oxygenates to all-hydrocarbon gasoline results in alterations in blend compositions which subsequently leads to increase in octane number, reduction in aromatic content, and reduction in volatility . Such alterations contribute to lower CO and HC exhaust tailpipe emissions . Moreover, blending of these oxygenates reduces CO emissions by enleaning the fuel-to-air mixture . Enleanment generally has the most influential effect in reducing CO emissions . The obtained NO_x emissions, due to oxygen addition, is lower than hydrocarbon fuel of equal octane number .

CONCLUSIONS AND RECOMMENDATIONS

1-Reformulating gasoline to reduce emissions from the existing automobile fleet in Egypt, is now a recognized option.

2-All engine 1986 and newer, originally approved to run on unleaded fuel, will not require any modifications to run on oxygenated gasoline.

3-Oxygenate is a term used in petroleum industry to denote octane enhancer components including ether such as MTBE and alcohol such as ethanol .

4-Oxygenated gasoline's, which have been marketed for years in Egypt, are all ether-gasoline blends MTBE is the most frequently used up till now .

5-Reformulated gasoline (RFG) also contain oxygenates but under other compositional and property alterations to reduce ozone forming emissions .

6-Reformulated gasoline programs are directed toward reducing ground-level ozone year-round in USA cities with the worst ground-level ozone .

7-Oxygenates provide chemical enleanment of the air / fuel charge thereby improving combustion and reducing tailpipe emissions of carbon monoxide (CO).

8-Addition of ether oxygenate to all-hydrocarbon gasoline formulations, causes volatility reduction which is directly related to the amount of blended ether .

9-When the composition of all-hydrocarbon gasoline is kept unaltered, a linear equation relating volatility reduction and the volume percent of blended ether, is developed .

10-Oxygenated gasoline's, having 2.0 - 2.7 oxygen content do not create excessive corrosion in the vehicle fuel system or alter fuel's oxidation stability standards .

11-Blending the maximum permitted level of MTBE, ETBE or TAME with two- , three- , or four- refinery gasoline components, does not significantly alter the storage life of the formulated oxy- fuels .

12-In oxygenated gasoline formulations consisting of the same components, mid-range volatility (E100) is affected by changing blend composition. Front-end (E70) and tail-end (E150) volatilities are not affected unless the change is severe .

13-When the composition of hydrocarbon portion is kept unchanged, the maximum permitted levels of MTBE, ETBE or TAME can contribute 2.5 - 3.0 octane numbers to the formulated gasolines .

14-Reformate which constitutes relatively higher aromatic content, contributes more efficiently in anti-knock property than isomerate .

15-Further addition of ether oxygenate results in more reduction in gasoline's RVP. changing blend composition is a suitable outlet for increasing RVP.

16-Though Reformulation of the available gasoline components in the local market, gasoline properties can be altered to meet seasonal changes .

17-Hydrocarbon pollutants from tailpipe and evaporative emissions, can react with NO_X in heat and sunlight to form ground-level ozone, which is the primary ingradients of smog .

18-Significant reduction in CO, HC and NO_X tailpipe exhaust emissions of the examined oxygenated gasolines if compared with all-hydrocarbon blends .

19-Driveability index (DI) is directly related to HC and CO emissions .

20-HC emissions increase significantly at DI levels higher than 570 .

21-Research's immediate efforts is to find gasoline recipes that reach a reasonable optimum between the amount of emissions reductions versus the cost to achieve that reduction.

22-Further studies should be carried out to determine the oxygenated gasoline properties that most influence emissions . Other refinery streams should be introduced to provide more flexibility in blending process.

23-Alkylate and iso-octane are attractive gasoline blend components to deal with supply issues if MTBE is eliminated .

24-The long- term use of other ether-based oxygenates may be limited .

25-Media reports, concerning the improvements in measured air quality, confirm that MTBE reduces carbon monoxide, greenhouse gas emissions and smog forming compounds .

26-The overwhelming majority of scientific evaluations to date have not identified any health-related risks to humans from the intended use of MTBE in gasoline .

27-MTBE does not accumulate in the body and it has not been shown to impair fertility, or damage a developing fetus or the genetic structure of cells .

28-Extensive research indicates that the MTBE does required to produce illness in laboratory animals are thousands of times greater than those to which humans could conceivably be exposed.

29-Some organizations and environmental groups have all argued that current knowledge suggests that MTBE is a less serious pollutant than gasoline components it replaces .

30-Numerous governments and world-renowned independent health organizations have found no sufficiently compelling reason to classify MTBE as a cancer-causing agent for humans.