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NO_X EMISSION FROM A SPARK IGNITION ENGINE USING 30% ISO-BUTANOL–GASOLINE BLEND: PART 1—PREHEATING INLET AIR

F. N. Alasfour
Mechanical Engineering, Kuwait University, P.O. Box 5969, Safat 13060, Kuwait

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Abstract—This research investigated the effect of using a 30% iso-butanol–gasoline blend on NO_x emission in a spark ignition engine. The influence of preheating inlet air on NO_x emission was also investigated at different fuel/air equivalence ratio. A single cylinder Hydra research engine was used, running at 1500 rpm over a wide range of fuel/air equivalence ratio (0.7–1.1). It was observed that by using the 30% iso-butanol–gasoline blend, the maximum level of NO_x emission is reduced by 9% compared to gasoline and the reduction of NO_x level was evident in the rich region. The experimental investigations were performed under different values of inlet air temperatures. Preheating the inlet air above ambient temperature causes the NO_x emission level to increase for all fuel/air equivalence ratios. At $\Phi = 0.90$, a 10% increase in NO_x was observed when the inlet air temperature increased from 40 to 60°C. For 30% iso-butanol–gasoline blend experimental results show that preheating inlet air causes knock and misfire to occur at less advanced ignition timing. © 1998 Elsevier Science Ltd. All rights reserved

Keywords—Iso-butanol, NO_x emission, air preheating, spark ignition engine.

NOMENCLATURE

BSFC	brake specific fuel consumption (g/kW h)
BTDC	before top dead center
MBT	maximum brake torque
ppm	part per million
rpm	revolution per minute
TDC	top dead center
Φ	fuel/air equivalence ratio

1. INTRODUCTION

1.1. *Iso-butanol*

Various studies have shown that the substitution of alcohol–gasoline vehicles for conventional hydrocarbon fueled vehicles could significantly reduce the level of NO_x emission [1–3]. Pure ethanol is being used as a spark ignition engine fuel in Brazil. In the United State gasohol, 10% ethanol–gasoline blend, is offered at thousands of service stations as automobile fuel.

Alcohols such as methanol (CH_3OH), and ethanol (C_2H_5OH) have received considerable attention recently because they are considered as highly efficient, and low-polluting future fuels through their lean operating ability [4]. The oxygen presence in alcohol fuel provides soot-free combustion with low particulate level. Iso-butanol (C_4H_9OH) is an attractive alcohol fuel because of its high heating value compared to methanol and ethanol. Iso-butanol heating value represents 77% of gasoline heating value, and it has the advantage of a low affinity for water. Phase separation in the presence of water is the most disturbing problem with alcohol–gasoline blends. Investigations show that alcohols with 3 to 8 carbon atoms are more effective for water solubility in blends [5]. Iso-butanol has been used as a cosolvent to improve the phase stability of methanol–gasoline and ethanol–gasoline blends [6]. The high octane number of iso-butanol makes it inherently adaptable as fuel for conventional spark ignition engine [7, 8]; Properties of some alcohol fuels are listed in Appendix A.