Impact of alcohol–gasoline fuel blends on the exhaust emission of an SI engine

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1. Introduction

Energy diversity is a vital factor for economic growth and environmental protection. Building a strong base of energy resources is necessary for concern the efforts which are made to search a potential alternate. Both ethanol and methanol can be produced from various biomass resources. It should be noted that methanol can be only produced from natural gas due to economic reasons [1]. Ethanol and methanol have low cetane number which may lead insufficient self-ignition quality for direct use of these alcohols in unmodified diesel engines. The key property of ethanol and methanol is their high octane number. The addition of ethanol or methanol to gasoline reduces the octane value of gasoline and raises the octane number. The addition of ethanol or methanol to gasoline reduces the octane value of gasoline and reduces engine knock, without affecting the efficiency of the catalytic converter [4]. Indeed, when Henry Ford designed his first automobile (Model T), it was built to run on both gasoline and pure ethanol [5]. In the past, ethanol had not been used widely due to its insufficient production and high production cost. But, nowadays, increasing global concern due to air pollution caused by internal combustion engines has generated much interest on the environmentally friendly alternative fuels.

So far, experimental studies [6–9] have been claimed that the ethanol or methanol blended fuels reduce exhaust emissions compared to gasoline fueled engine. Generally, in these studies, the reductions in the exhaust emissions have been associated with the oxygen content in ethanol and methanol. It is well-known that the physical and chemical properties of ethanol or methanol are completely different from those of gasoline. Especially, their energy contents are lower than that of gasoline, both on mass and volume basis. This property shows that the engine will need more amount fuel when it is fueled with ethanol or methanol blends to produce the same power output in a gasoline-fueled engine. This case will change air–fuel ratio in the cylinder and exhaust emission levels. One of the most important properties of methanol or ethanol is the oxygenated atoms in their molecular compounds which provide significant reduction in the CO and HC emissions, but it may be adversely affect NOx emissions. Methanol has a heat of vaporization that is about 3 times higher than gasoline; ethanol has higher heat of vaporization about 2.5 times (see Table 1). It can be considered that the mixture temperature will be influenced because of the cooling effect from the vaporization of ethanol or methanol,