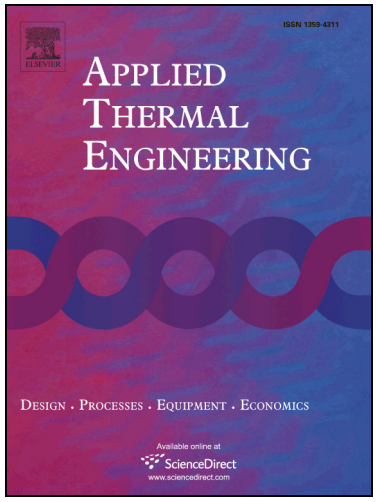

Experimental investigation on the effects of compression ratio on in-cylinder combustion process and performance improvement of liquefied methane engine

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PII: S1359-4311(16)32391-2
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2016.11.048
Reference: ATE 9459

To appear in: *Applied Thermal Engineering*

Received Date: 13 October 2016
Revised Date: 3 November 2016
Accepted Date: 6 November 2016

Please cite this article as: J. Fu, J. Shu, F. Zhou, J. Liu, Z. Xu, D. Zeng, Experimental investigation on the effects of compression ratio on in-cylinder combustion process and performance improvement of liquefied methane engine, *Applied Thermal Engineering* (2016), doi: http://dx.doi.org/10.1016/j.applthermaleng.2016.11.048

Experimental investigation on the effects of compression ratio on in-cylinder combustion process and performance improvement of liquefied methane engine

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Abstract: A novel approach was proposed to improve the performance of liquefied natural gas (LNG) engine. The LNG is first purified into liquefied methane and then used as engine fuel. Since the octane number of methane is higher than other compositions of natural gas, the compression ratio of liquefied methane engine (LME) can be increased for improving thermal efficiency. To verify the performance improvement potential of this approach, the experiment was conducted under varied compression ratios, and then the effects of compression ratio on in-cylinder combustion and heat-work conversion processes were analyzed. The results show that, peak heat release rate of LME is not very sensitive to compression ratio, so does the 10-90% combustion duration. With the rise of compression ratio, ignition delay period is reduced and start of combustion (SOC) is advanced. LME torque is increased by 9.5% at most while BSFC is reduced by a maximum of 10.9% under the studied conditions. NOx emissions ascend obviously with compression ratio increasing but this problem can be solved by retarding ignition timing. When other parameters are unchanged, the available compression ratio of LME can be increased to 15.6 or so without obvious knocking, which indicates great performance improvement potential for LME.

Keywords: methane; natural gas engine; compression ratio; combustion; emission; knocking

1. Introduction

With the increase of car ownership and the rapid development of industry, the world is facing two increasingly serious problems of fuel crisis and environmental pollution [1-4]. Taking China as an example, more than 60% of the petroleum was consumed by vehicle, and more than 1/3 of harmful emissions were derived from transportation. In order to alleviate the increasingly serious fuel crisis and cope with the stringent emission regulations, scientists are making unremitting efforts to continuously search for the clean and efficient alternative fuels for internal combustion engine (ICE) [5,6]. Due to the advantages of abundant resource, high octane, low prices and less pollution emissions, natural gas has been used as an alternative fuel for ICE in recent decades. It can not only ease the contradiction between fuel supply and demand to some extent, but also effectively reduce the pollutant emissions of ICE [7-10]. Therefore, natural gas is considered as the most promising one of the vehicle alternative fuels [11-14]. Furthermore, the technical improvements in long-distance transport, purification, dehydration and storage, have provided convenient conditions for the development of natural gas vehicles. It is well known that natural gas has two major application ways as the vehicle alternative fuel, one is compressed natural gas (CNG) and the other is liquefied natural gas (LNG) [15]. In general, LNG

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