INTERNATIONAL JOURNAL OF AUTOMOTIVE AND MECHANICAL ENGINEERING (IJAME)
ISSN 2229-8649 e-ISSN 2180-1606
VOL. 18, ISSUE 2, 8790 – 8801
DOI https://doi.org/10.15282/ijame.18.2.2021.17.0673

Scopus

Universiti Malaysia PAHANG

ORIGINAL ARTICLE

Effect of Injection System Parameters on Performance and Emission Characteristics of a Small Single Cylinder Diesel Engine

D.K. Dond* and N.P. Gulhane

Mechanical Department, Veermata Jijabai Technological Institute, Mumbai 400019, India
Mob. No. +919730992895 / +918668349918

ABSTRACT – Limited fossil fuel reservoir capacity and pollution caused by them is the big problem in front of researchers. In the present paper, an attempt was made to find a solution to the same. The conventional fuel injection system was retrofitted with a simple version of the common rail direct injection system for the small diesel engine. Further, the effect of injection system parameters was observed on the performance and emission characteristics of the retrofitted common rail direct injection diesel engine. The parameters such as injection pressure, the start of pilot injection timing, the start of main injection timing and quantity of percentage fuel injection during the pilot and main injection period were considered for experimental investigation. It was observed that all the evaluated parameters were found vital for improving the engine's performance and emission characteristics. The retrofitted common rail direct injection system shows an average 7% rise in brake thermal efficiency with economic, specific fuel consumption. At the same time, much more reduction in hydrocarbon, carbon monoxide and smoke opacity with a penalty of a slight increase in nitrogen oxides.

ARTICLE HISTORY
Received: 3rd May 2020
Revised: 7th June 2021
Accepted: 5th July 2021

KEYWORDS
CRDI small diesel engine;
Injection pressure;
Injection timing;
Emissions characteristics;
Performance characteristics

NOMENCLATURE

bTDC	before top dead centre	CA	crank angle
aTDC	after top dead centre	IT	injection timing
TDC	top dead center	IP	injection pressure
EGT	exhaust gas temperature	SOMI	start of main injection
CRDI	common rail injection system	SOPI	start of pilot injection
BTE	brake thermal efficiency	HC	hydrocarbon
BSFC	brake specific fuel consumption	CO	carbon monoxide
EGR	exhaust gas recirculation	NOx	nitrogen oxides

INTRODUCTION

Small single-cylinder diesel engines are mainly used for stationary as well as mobile applications. Exhaust gases emitted from these engines had polluted most of the cities in our country [1]. Many of these engines use a mechanical fuel injection system for delivering the required quantity of fuel at the time of combustion stroke. Such a conventional injection system does not have precise control over the delay period, injection pressure, duration of injection and rate of injection. All these factors lead to fuel wastage and atmospheric pollution from small diesel engines. Electronic fuel injection systems used earlier for large diesel engines have the flexibility to change the injection strategy and multiple injection capabilities. The fuel injection system parameters such as injection pressure (IP), fuel injection rate, multiple injections, and the start of injection under different engine operating conditions can be effectively control using an electronic injection system [2]. Researchers had tried to design and implement such an electronic injection system for small diesel engines.

In the past, a lot of experimental work was carried out on small single-cylinder diesel engines in order to improve efficiency and reduced emission. Most of the researchers carried their research work by changing the combustion parameter simultaneously, such as fuels, IP, injection timing (IT), percentage of exhaust gas recirculation (EGR) and compression ratio on conventional small diesel engines. Mehmet [3] and Emiroglu [4] done the trial on a diesel engine at different IPs (190, 210 and 230 bar) for two different loads and speeds. The result shows that the increase in IP shows a reduction in soot formation. Also, similar type experiments were carried out by many other researchers [5-6]. The mechanical injection system of conventional small diesel engines could not solve the problem of pollution and performance. For the last decade, researchers had tried to implement the electronic injection system for small diesel engines. Many authors had retrofitted the conventional injection system with an available electronic common rail direct injection (CRDI) system on a small diesel engine and conducted trials. Until today, the work will find the optimum injection system parameters to maximise the overall engine performance. Agrawal et al. [7-9] conducted experiments on a small single-cylinder diesel engine. The conventional injection system of the engine was replaced with CRDI without

*CORRESPONDING AUTHOR | Dipak Kisan Dond | dpkdnd@gmail.com