



## Dr. MUSHTAQ AHMAD RATHER

PhD. Mechanical Engineering

### PROFILE

An experienced, enthusiastic and focused educational professional who is totally committed to imparting and promoting the latest developments in the field of technological education and research and development. Dr. Mushtaq is passionate about giving young students the best possible guidance to excel in technical education and enjoys working in a busy environment. Right now looking for a suitable position with a reputable academic establishment.

### CONTACT

#### Address

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#### Phone

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E-Mail: [mushi.3afn@gmail.com](mailto:mushi.3afn@gmail.com)

### PROFESSIONAL

Able to create vibrant and effective learning workplace.

Familiar with a variety of approaches to teaching students.

Able to work under deadline pressure.

### PERSONAL

#### Date of Birth:

21March1981

#### Gender:

Male

### CARRIER

Institute	Position	Duration
Jamia Millia Islamia, New Delhi	Assistant Professor	July 2024- May 2025
Institute of Technology, University of Kashmir Zakura Campus Srinagar Kashmir, INDIA	Lecturer	April 2023- Dec. 2023
Institute of Technology, University of Kashmir Zakura Campus Srinagar Kashmir, INDIA	Lecturer	March 2022- March 2023
SSM College of Engineering, Baramulla, Kashmir, INDIA	Associate Professor and Head Mechanical Engg. Deptt.	2011-2015
SSM College of Engineering, Baramulla, Kashmir, INDIA	Assistant Professor	2005-2008

### SKILLS

Engineering Drawing, Autocad, Computational Fluid Dynamics, Ansys

### ACADEMIC

Qualification	Year	University/Board
PhD	2021	National Institute of Technology, Srinagar
M.Tech.	2011	National Institute of Technology, Srinagar
B.E (Mechanical)	2005	University of Kashmir

### PUBLICATIONS

**Mushtaq Ahmad Rather, M M Wani.** Effect of steam addition on the combustion, performance and emissions characteristics of an HCCI diesel engine . Journal of Thermal Engineering. (Vol. 10, No. 3, pp. 710-721, May, 2024 )

**Mushtaq Ahmad Rather, Mohammad Marouf Wani.** A Numerical Study on the Effects of Exhaust Gas Recirculation Temperature on Controlling Combustion and Emissions of a Diesel Engine running on HCCI Combustion Mode. International Journal of Automotive

ScienceandTechnology,Vol.2,No.3,2018, pp.17-27.

**M A Rather, M M Wani.** Computational study on the effects of exhaust gas recirculation on thermal and emission characteristics of HCCI diesel engine. International Journal of Automotive Engineering, Vol. 8, No.4, 2018, pp. 2833-2839.

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR



Hazratbal, Srinagar, Kashmir, 190006, J&K, India

PROVISIONAL CERTIFICATE  
DOCTORATE OF PHILOSOPHY

Certificate No. 149

Registration No. NIT-Ph.D-135-2015

Enrolment No. 2015-Ph.D-FOE-Autumn-37

Certified that Mushtaq Ahmad Rather

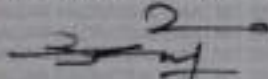
S/o, D/o Gh. Ahmad Rather has completed

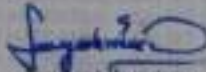
the requirements for award of Ph.D in the Faculty of Engineering

**Thesis Title**


*"An Investigation on the Performance of HC/CI Diesel Engine under the Influence of Various Working & Geometric Parameters"*

Date of Viva-Voce: 26/11/2021

  
Dealing Assistant

  
Assistant Registrar  
Academic

  
Associate Dean  
Examinations

  
Dean Academic  
Affairs

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# NATIONAL INSTITUTE OF TECHNOLOGY

HAZRATBAL SRINAGAR KASHMIR,



Provisional Certificate

Master of Technology

Certificate No. **085**

Registration No. **NIIT-MTD-145-2009**

Roll No. **9702**

Enrolment No. **62/08**

Result Notification No. **06/NIIT/M.Tech/M.S.D/3rd & 4th Sem. Dec. Jan, 2009-10 & January**

Certified that **Mr./Ms. Mustdog, Ahmad Rather** **01-05-04-2011** **2011**

Son / Daughter of **Gh. Ahmad Rather**

who appeared in M.Tech. Final Examination in **Mechanical System Design**

held in **January, 2011** has been declared successful in the said

examination & obtained Cumulative Grade Point Average of (CGPA) **7.600**

on a scale of 10.

Date of Issue **28-04-2011**

Assit. Registrar

Controller of Exams.

Dean  
(Academic)

**Notes:** This certificate is given only with the object of enabling the student to further studies or to seek a job & is not to be held equivalent to the degree certificate to be given to him/her by the National Institute of Technology, Srinagar.



Cert. No. MT **1091**

**NATIONAL INSTITUTE OF TECHNOLOGY**  
 Hazratbal, Srinagar 190006, Kashmir, J & K, INDIA,

**M. Tech. Grade Card**

Name: MR. MUSHTAQ AHMAD KATHER  
 Enrollment No: 0208  
 Programme: M. Tech (Mechanical Systems Design)  
 Registration No: NIT-MSD-145-2008

1 <sup>st</sup> Semester: Roll No: 8302 Session: Feb-2009				2 <sup>nd</sup> Semester: Roll No: 9402 Session: July-2009				
Subject Code	Subject Name	CRD	GRD	Subject Code	Subject Name	CRD	GRD	
MEU-101	Computer Aided Design (SolidWorks)	04	C	MEU-201	Computer Aided Design	04	C	
MEU-102	Failure Assessment Method	04	B+	MEU-202	Control of Fatigue Structures	04	B+	
MEU-103	Mathematics (Numerical Methods)	04	B	MEU-203	Operation Research (Mathematics)	04	B+	
MEU-104	Programmable System Control	04	B+	MEU-204	Advanced Control System	04	C	
MEU-107	Advanced Engine Design	04	A	MEU-207	Engine Simulation	04	B	
<b>Total Credits Earned</b>		<b>20</b>		<b>Total Credits Earned</b>		<b>20</b>		
<b>SGPA = 7.40</b>				<b>SGPA = 6.80</b>				
3 <sup>rd</sup> & 4 <sup>th</sup> Semester: Roll No: 8702 Session: Dec-Jan-2009-2010(3 <sup>rd</sup> Sem) Jan-2011(4 <sup>th</sup> Sem)				Minimum Number of Credits Required:				60
5 <sup>th</sup> & 6 <sup>th</sup> Semester: Roll No: 9702 Session: Dec-Jan-2010-2011(5 <sup>th</sup> Sem) Jan-2012(6 <sup>th</sup> Sem)				Number of Credits Earned:				60
MEU-301	Seminar	04	B+	<b>C.G.P.A</b>				<b>7.000</b>
MEU-302	Dissertation	16	A	<b>Result</b>				<b>PASS</b>
<b>Total Credits Earned</b>		<b>20</b>						
<b>SGPA = 8.80</b>								

How to award Grades & Equivalent Credits

Awards of Grades					
A+	A	B+	B	C+	C
90-100%	80-90%	70-80%	60-70%	50-60%	40-50%
4	3	2	1	0	0

Grading: C.G.P.A. & C.D.P.A. are on 100% weight.

Section Officer: *[Signature]*  
 Assistant Registrar (Acad): *[Signature]*  
 Controller of Examinations: *[Signature]*

1. Result Notification No. 01/NIT/M Tech /1st Sem. (M.Tech) Session, February-2009 Dated: 20-12-2009  
 2. Result Notification No. 01/NIT/M Tech (MSD) 2<sup>nd</sup> Sem. Session, July-2009 Dated: 30-01-2010  
 3. Result Notification No. 06/NIT/M Tech/MSD/3<sup>rd</sup> & 4<sup>th</sup> Sem of Dec-Jan 2009-2010 and Jan-2011 Dated: 05-04-2011

# University of Kashmir

Accredited "A" by NAAC



## Bachelor of Engineering

This is to Certify that **Mushtaq Ahmad Rather**  
Son of **Ghulam Ahmad Rather**  
of the **S S M College of Engineering** has been  
admitted to the Degree of

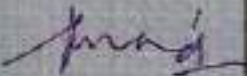
## Bachelor of Engineering

in the discipline of **Mechanical Engineering**  
in the year **Nov.-Dec/2004** and that he was placed in the  
**Second Division**

  
Controller of Examinations




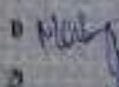
Photograph of the Degreee

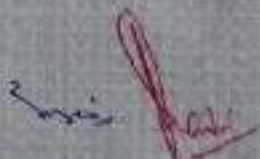
  
Vice Chancellor

University Campus  
Baramulla, Jammu-191006



Roll No 5775006  
Date No 82-2000-29  
Certificate No 358

Prepared By   
Checked by 



# The University of Kashmir, Srinagar.

The mere possession of this sheet does not in itself confer any right or privilege independent of the proper qualification certificate which will be issued in due course of time.

N<sup>o</sup> 000530

Roll No. 9108

Regd. No. 14860-10-99

## Four Year Bachelor of Engineering (Final) Mechanical

Examination held in December-January Session 2004Name of the Candidate: Mushtaq Ahmad Rather

S. No	Course Title	Max. Marks			Marks Obt.		
		Theory	Seasonal	Practical	Theory	Seasonal	Practical
1.	Industrial Management	100	50	—	73	43	—
2.	Elective <u>Opp. Research</u>	100	50	—	67	42	—
3.	Elective <u>R. A. C</u>	100	50	—	65	44	—
4.	Elective <u>Automatic Control</u>	100	50	—	65	37	—
5.	Elective <u>J. E. Engg.</u>	100	50	—	56	35	—
6.	Project	200	50	—	164	42	—
7.	<u>Mechanical Engg. Practical</u>	—	—	100	—	—	25
	(a) Practical Training 5th & 7th	—	—	100	—	—	25
	(b) Professional/viva	—	—	—	—	—	—
		700	300	200	490	243	150
Total		1200	—	—	883	—	—
Marks Obtained in I Semester		800	—	—	493	—	—
Marks Obtained in II Semester		1000	—	—	587	—	—
Marks Obtained in III Semester		1000	—	—	622	—	—
Marks Obtained in IV Semester		1000	—	—	647	—	—
Marks Obtained in V Semester		1000	—	—	604	—	—
Marks Obtained in VI Semester		100	—	—	652	—	—
Marks Obtained in VII Semester		1000	—	—	662	—	—
Marks Obtained in I-VIII Semester		8000	—	—	5152	—	—

Result :- PASSMarks obtained (if passed) in words Five Thousand OneHundred and fifty twoNote :- The marks of the subject/s in which the candidate has failed are encircled  
Errors & Omissions ExceptedThe University Campus,  
Hazratbal Srinagar - 190006Date of Declaration of Result 20th March 2004

Dy. Asstt. Controller of Exams.

सं. संख्या  
S.NO. SSE/95/ 00066336

केन्द्रीय माध्यमिक शिक्षा बोर्ड  
Central Board of Secondary Education

सेकण्डरी स्कूल परीक्षा, 1995  
ALL INDIA SECONDARY SCHOOL EXAMINATION, 1995

यह प्रमाणित किया जाता है कि

This is to certify that **MUSHTAQ AHMAD RATHER**

अनुसूचक

Roll No. **2117921** Son ~~XXXXX~~ of Son **GH AHMAD RATHER**

जिसकी जन्म तिथि

born on **TWENTY FIRST MARCH NINETEEN HUNDRED AND EIGHTY ONE**

है. कि बोर्ड द्वारा मार्च, 1995 में आयोजित सेकण्डरी स्कूल परीक्षा

passed the Secondary School Examination of the Board held in March, 1995

विद्यालय से

from **J. B. K. SAINIK SCHOOL HANASBAL KASHMIR**

निम्न विषयों में उत्तीर्ण की -

in the following subjects :

- |                      |                  |                   |
|----------------------|------------------|-------------------|
| 1 ENGLISH COURSE-A   | 2 HINDI COURSE-A | 3 MATHEMATICS     |
| 4 SCIENCE WITH PRAC  | 5 SOCIAL SCIENCE | 6 WORK EXPERIENCE |
| 7 PHY & HEALTH EDUCA | 8 ART EDUCATION  |                   |

दिल्ली  
Delhi

दिनांक

Dated 14-08-1995



*K. Sharma*

परीक्षा नियंत्रक  
Controller of Examinations

केन्द्रीय माध्यमिक शिक्षा बोर्ड  
Central Board of Secondary Education

\* या विषय विरुद्ध लिखित बोर्ड के अंके लगे हैं. यह लिखित परीक्षाओं में उत्तीर्ण परीक्षा में दर्शाते हैं।

\* against a subject indicates that the candidate passed in the subject at the Compartmental examination.



# SSM COLLEGE OF ENGINEERING

(Approved & Recognized by AICTE New Delhi & Govt. of J&K)

Affiliated to the university of Kashmir

ISO 9001:2015 Certified

## EXPERIENCE CERTIFICATE

Certified that **Dr. Mushtaq Ahmed Rather** has worked as **Assistant Professor** which post is of the level of **10** in the discipline of **Mechanical Engineering** in **SSM College of Engineering, Parihaspota**, which is a Government recognized private institution, with effect from **05/09/2005 to 10/09/2008, and 06/04/2011 to 10/08/2015**.

The institution is recognized by the Government of J&K vide No. HE/Recog-234/K/2015 dated 14/09/2015 for a period of 7 years from 14/09/2015.

NO: SSM/EX/2019/206/Admn  
Dated: 30-07-2022

Signatures of the Head of the Institution





- i) It is certified that the beneficiary has continuously attended the institution from 05/09/2005 to 10/09/2008, and 06/04/2011 to 10/08/2015.
- ii) It is certified that the salary has been drawn by the beneficiary from 05/09/2005 to 10/09/2008, and 06/04/2011 to 10/08/2015 through J&K Bank Ltd.



Countersigned by

Signatures of Dist/ Divisional/ State Authority

Dated:

  
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OFFICE OF THE DIRECTOR  
INSTITUTE OF TECHNOLOGY  
UNIVERSITY OF KASHMIR  
(NAAC Accredited Grade 'A+')  
Zakura Campus, Srinagar – 06

No. F(Exp-cert-CL)IOT/KU/23  
Dated: May 02, 2023

Experience Certificate

Certified that Dr Mushtaq Ahmad Rather S/O Gh. Ahmad Rather R/O Dhobipora Ganderbal has worked as Contractual Lecturer in the discipline of Mechanical Engineering in Institute of Technology, University of Kashmir, which is a government institution, with effect from 31<sup>st</sup> March 2022 to 31<sup>st</sup> January 2023, with a break of 01 day after every 89 days.

  
Coordinator

Department of Mechanical Engineering

Coordinator  
Department of Mechanical Engineering  
Institute of Technology, Zakura Campus  
University of Kashmir, Srinagar



Director  
Institute of Technology  
Institute of Technology  
University of Kashmir  
Srinagar



OFFICE OF THE DIRECTOR  
INSTITUTE OF TECHNOLOGY  
UNIVERSITY OF KASHMIR  
(NAAC Accredited Grade 'A+')  
Zakura Campus, Srinagar – 06

No. F(Exp-cert-CL)IOT/KU/23  
Dated: May 02, 2023

Experience Certificate

Certified that Dr Mushtaq Ahmad Rather S/O Gh. Ahmad Rather R/O Dbobipora Ganderbal has worked as Contractual Lecturer in the discipline of Mechanical Engineering in Institute of Technology, University of Kashmir, which is a government institution, with effect from 16<sup>th</sup> February 2023 till date, with a break of 01 day after every 89 days.

Coordinator

Department of Mechanical Engineering

Coordinator  
Department of Mechanical Engineering,  
Institute of Technology, Zakura Campus  
University of Kashmir, Srinagar

Director

DIRECTOR  
Institute of Technology (IOT)  
University of Kashmir  
Srinagar

स्थापना शिक्षण अनुभाग, कुलसचिव कार्यालय, जामिया मिल्लिया इस्लामिया  
Establishment Teaching Section, Registrar's Office  
Jamia Millia Islamia

F. No. Gen. 89/ JMI/Estt. (I)/RO/2024

Dated:06.08.2024

**Sub: Joining Report**

In pursuance of the Office Order No.GT-24-25/RPS/RO/JMI dated 29.07.2024 the following Assistant Professor (Contractual) & Guest Faculty have joined their duties in the Deptt. of Mechanical Engineering, Faculty of Engineering, JMI, during the Academic Session 2024-25, as per details given below.

S. No.	Name of the Employee	Date of Joining
1	Dr. Md. Hasan Assistant Professor(Contractual) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
2	Dr. Md. Rahid Akhtar Assistant Professor(Contractual) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
3	Dr. Azhar Equbal Assistant Professor(Contractual) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
4	Dr. Osama Khan Assistant Professor(Contractual) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
5	Dr. Sameera Mufazzal Assistant Professor(Contractual) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
6	Dr. Mohammed Istafaul Haque Ansari Assistant Professor(Contractual) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
7	Dr. Mushtaq Ahmad Rather Assistant Professor(Contractual) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
8	Dr. Mohd Imran Ansari (Guest Faculty) for teaching B. Tech programme(under Self Finance Programme) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)
9	Dr. Mohd Shaaban Hussain (Guest Faculty) for teaching B. Tech programme(under Self Finance Programme) Deptt. of Mechanical Engineering, JMI	31.07.2024 (Forenoon)

Authority: The Reference Office Order No.GT-24-25/RPS/RO/JMI dated 29.07.2024

Yours faithfully

*Naseem*  
06/08/24  
(Naseem Fatima)  
Assistant Registrar (E-T)

Copy forwarded for information & necessary action to:

1. The Dean, Faculty of Engineering, JMI
2. The Head, Department of Mechanical Engineering, JMI
3. The Assistant Finance Officer (Payments), JMI
4. The Assistant Registrar (RPS), JMI
5. Person Concerned
6. File/ Folder (E-T).

## LIST OF PUBLICATIONS

1. **Mushtaq Ahmad Rather**, M M Wani. Effect of steam addition on the combustion, performance and emissions characteristics of an HCCI diesel engine . Journal of Thermal Engineering. (Vol. 10, No. 3, pp. 710-721, May, 2024 ) **(ESCI, Scopus Indexed)**
2. **Mushtaq Ahmad Rather**, Mohammad Marouf Wani. A Numerical Study on the Effects of Exhaust Gas Recirculation Temperature on Controlling Combustion and Emissions of a Diesel Engine running on HCCI Combustion Mode. International Journal of Automotive Science and Technology, Vol.2, No.3, 2018, pp. 17-27. **(Scopus Indexed)**
3. **M A Rather**, M M Wani. Computational study on the effects of exhaust gas recirculation on thermal and emission characteristics of HCCI diesel engine. International Journal of Automotive Engineering, Vol. 8, No.4, 2018, pp. 2833-2839. **(Peer Reviewed)**



Research Article

## Effect of steam addition on the combustion, performance and emissions characteristics of an HCCI diesel engine

Mushtaq Ahmad RATHER<sup>1\*</sup>, M. M. WANI<sup>1</sup>

<sup>1</sup>Department of Mechanical Engineering, National Institute of Technology, Srinagar, J&K, 190006, India

### ARTICLE INFO

#### Article history

Received: 17 February 2023

Revised: 07 August 2023

Accepted: 30 August 2023

#### Keywords:

Diesel Engine; HCCI; NO<sub>x</sub> Emissions; Steam Addition; Thermal Characteristics; Unburned Hydrocarbons

### ABSTRACT

Although homogeneous charge compression ignition (HCCI) diesel engines are the favored source of power with near zero oxides of nitrogen (NO<sub>x</sub>) and particulate matter emissions owing to a higher degree of homogeneity and elimination of diffusion phase combustion, the main drawback is the uncontrolled start of combustion along with high CO and unburned hydrocarbon emissions. In the present work, experimental investigations were carried out on a single cylinder diesel engine operating in HCCI combustion mode using external air-fuel mixture preparation. The regulated percentage of steam is added inside the mixing chamber and the effects on the combustion, performance and emission characteristics were reported for various steam injection rates at different brake mean effective pressures. The results obtained show that the brake thermal efficiency was improved to 21.048% with the addition of 20% steam addition and the NO<sub>x</sub> emissions were also reduced significantly. The emissions of CO and unburned hydrocarbon were found 0.7% and 93 ppm respectively at the steam addition rate of 20%, however a rapid increase was observed if the steam injection rate was increased further. Overall, the present work shows that by the addition of steam, the CO and unburned hydrocarbon emissions can be reduced significantly along with NO<sub>x</sub> emissions and also there is a greater potential to control the start of combustion.

Cite this article as: Rather MA, Wani MM. Effect of steam addition on the combustion, performance and emissions characteristics of an HCCI diesel engine. J Ther Eng 2024;10(3):710–721.

### INTRODUCTION

The homogeneous charge compression ignition (HCCI) diesel engines are expected to be the favored source of power for heavy industrial and transportation sector with high power output and low exhaust emissions. The HCCI technology addresses the challenges in terms of NO<sub>x</sub> (Oxides of Nitrogen) and particulate matter (PM) pollutants that result due to combustion of heterogeneous air-fuel charge [1-2].

However, HCCI engine has disadvantage of high CO and PM emissions [3]. The PM can be reduced by using Diesel Oxidation Catalysts (DOCs) and Diesel Particulate Filters (DPFs). DOCs are suitable only for non-road applications and are capable of reducing PM to 25% or more. DPFs, are more expensive and are able to reduce the formation of PM by up to 90% and work effectively on engines that are able to sustain high exhaust temperature [4]. Furthermore, in HCCI diesel engine there is no direct control on the

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This paper was recommended for publication in revised form by Editor-in-Chief Ahmet Selim Dalkılıç



Published by Yıldız Technical University Press, Istanbul, Turkey

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## A Numerical Study on the Effects of Exhaust Gas Recirculation Temperature on Controlling Combustion and Emissions of a Diesel Engine running on HCCI Combustion Mode

Mushtaq Ahmad Rather<sup>1\*</sup> and Mohammad Marouf Wani<sup>1</sup>

<sup>1</sup> Department of Mechanical Engineering, National Institute of Technology, Srinagar, Kashmir, J&K, 190006, India

### Abstract

In this study a comprehensive study is carried out numerically on a single cylinder four-stroke Diesel engine operating in homogenous charge compression ignition (HCCI) mode of combustion for the effects of exhaust gas recirculation (EGR) temperature and percentage on the combustion and emission characteristics. An advanced version of ANSYS IC Engine FORTE coupled with highly efficient and detailed pre-defined industry standard chemical kinetics CHEMKIN is used to solve the chemical reaction mechanism and species thermodynamic data. The analysis was carried out at three different EGR temperatures of 363K, 404K and 513K for 10%, 20%, 30%, 40% and 50% EGR each. The results predicted that the combustion ignition timing is advanced by increasing the EGR temperature. It was found that the combustion timing was advanced by 3 degree crank angle by increasing the temperature of EGR from 363 K to 404 K and the heat release rate was reduced by 163.85J/degree of crank angle. The effect of low EGR temperature is predominant at higher percentages of EGR. It was also found that the CO and UHC levels nearly kept constant with an increase in EGR temperature the NO<sub>x</sub> levels increase linearly with an increase in EGR temperature. The HCCI combustion in diesel engine can be controlled by adjusting the temperature and mass percentage of exhaust gas recirculation while retaining lower NO<sub>x</sub> emissions and very little increase in CO and unburnt hydrocarbons.

**Keywords:** CHEMKIN; EGR; HCCI IC Engine FORTE; NO<sub>x</sub>; Thermal effects

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Manuscript Received 07.08.2018

Revised 13.09.2018

Accepted 14.09.2018

DOI:0.30939/ijastech.451574

### 1. Introduction

Homogenous charge compression ignition (HCCI) mode of combustion is an alternative combustion strategy for conventional diesel engine that offers the potential to high power output with significantly reduced exhaust emissions of NO<sub>x</sub> and Particulate matter [1,2]. HCCI engines encounter low temperatures during the combustion, producing high levels of emissions of HC and CO [3]. In HCCI engine, the fuel and air are mixed homogeneously before the start of combustion. The homogenous mixture auto-ignites as a result of the temperature increase during the compression stroke and burns volumetrically in a faster process giving a parallel energy release throughout the entire combustion zone. HCCI combustion is a chemical kinetic combustion process and is influenced by various factors like in-cylinder pressure, temperature, fuel characteristics and

composition of the charge within the cylinder. HCCI needs no centralized combustion initiation and correspondingly suffers lack of control of start of combustion [4]. Researchers have reported various strategies for the control of combustion phasing by adjusting the compressed gas temperature so that the charge mixture auto-ignites at the desired crank angle such as variable compression ratio [5], variable valve timing [6], and intake air heating [7]. The HCCI combustion and emissions are significantly affected by the initial temperature of the mixture [8]. The CO emissions can be reduced by modifying the key oxidation reaction rate constant.

Exhaust gas recirculation (EGR) is widely used to reduce the NO<sub>x</sub> emissions and is considered as the basic method to control the combustion phasing and burn rate in HCCI combustion engines. The auto-ignition and simultaneous combustion nature of HCCI engine limit the combustion



## Computational study on the effects of exhaust gas recirculation on thermal and emission characteristics of HCCI diesel engine

M A Rather<sup>1</sup>, M M Wani<sup>1</sup>

<sup>1</sup> Department of Mechanical Engineering, National Institute of Technology, Srinagar, J&K, 19006, India

### ARTICLE INFO

#### Article history:

Received: 04 Jun 2018  
Accepted: 20 Nov 2018  
Published: 01 Dec 2018

#### Keywords:

HCCI,  
NO<sub>x</sub>,  
EGR,  
Combustion phasing,  
Ignition delay,  
Unburned hydrocarbons

### ABSTRACT

In this paper, a computational in-cylinder analysis of HCCI diesel engine was carried out using IC Engine FORTE (ANSYS 18.2) software package. The analysis used pre-defined industry standard CHEMKIN format for specifying a chemical reaction mechanism during the combustion duration. The investigation was carried out for the effects of various EGR mass percentages on the thermal and emission characteristics of a diesel engine running on HCCI mode of combustion. It was observed that an increase in EGR concentration resulted in the decrease in peak in-cylinder pressure and temperature and it was also found that when the EGR rates were increased beyond 75% there was no combustion happening within the cylinder. A considerable decrease in the NO<sub>x</sub> emissions was found with an increase in EGR mass percentage with almost negligible values when the EGR rates were increased beyond 50%, however there was a slight increase in un-burnt hydrocarbons.