STUDY OF PERFORMANCE AND EMISSIONS OF C.I. ENGINE WITH PONGAMIA BASED BIODIESEL

DR. V. SITARAM PRASAD

Principal & Professor

Department of Mechanical Engineering
Abdul Kalam Institute of Technological Sciences,
Kothagudem, Telangana, INDIA

STUDY OF PERFORMANCE AND EMISSIONS OF C.I. ENGINE WITH PONGAMIA BASED BIODIESEL

Copyright© : Dr. V. Sitaram Prasad
Publishing Rights® : VSRD Academic Publishing

A Division of Visual Soft India Pvt. Ltd.

ISBN-13: 978-93-87610-99-6

FIRST EDITION, NOVEMBER 2023, INDIA

Printed & Published by: VSRD Academic Publishing

(A Division of Visual Soft India Pvt. Ltd.)

Disclaimer: The author(s) / Editor(s) are solely responsible for the contents compiled in this book. The publishers or its staff do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the Author(s) or Editor(s) or Publishers to avoid discrepancies in future.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the Publishers & Author.

Printed & Bound in India

VSRD ACADEMIC PUBLISHING

A Division of Visual Soft India Pvt. Ltd.

REGISTERED OFFICE

154, Tezab mill Campus, Anwarganj, KANPUR–208003 (UP) (IN) Mb:9899936803, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com

MARKETING OFFICE

340, FF, Adarsh Nagar, Oshiwara, Andheri(W), MUMBAI–400053 (MH) (IN) Mb:9956127040, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com

PREFACE

In present scenario, academics and practical knowledge are inseparable.

Author tried to give utmost importance to the basics of science and engineering, with which students of present generation can be benefitted from my research work. Governments (central and state) are also trying to reduce the cost of the fuel by encouraging the research works, related to alternative fuels. Sole intention of author is to utilize the resources available in rural areas and respective stake holders can be benefitted from my research work.

Thanking you,

Z Dr. V. Sitaram Prasad

ACKNOWLEDGEMENT

An extensive research project requires guidance, help, assistance and cooperation of several people. I humbly wish to acknowledge and express my gratitude to all such people, without whom my research work may not have seen the light of the day. I would like to thank my mother Mrs. (late) V. Javapradha and father Mr. V. Ekanadham without whom book may not be published. At the same time, I would like to thank my supervisor Dr. S.K. Mohaptra for giving me the opportunity to be part of this project and more importantly giving me moral support. I would also thank my wife Mrs. Madhavi (Vasundhara) and daughter Mrs. Greeshma for teir external support and understanding of my goals and aspirations. Without them. I would not have been able to complete much of what I have done and become who I am. They are the light that shines my way and the drive for ever persistent determinations.

ZDr. V. Sitaram Prasad
Principal & Professor
Department of Mechanical Engineering
Abdul Kalam Institute of Technological Sciences
Kothagudem, Telengana

CONTENTS

| CHAP | TER 1: INTRODUCTION1 |
|-------|--|
| 1.1. | INDIAN BIODIESEL INITIATIVE STORY2 |
| 1.2. | HISTORICAL AND HORTICULTURAL BACKGROUND OF PONGAMIA TREE13 |
| 1.3. | PONGAMIA SEED OIL16 |
| 1.4. | C. I. ENGINE FUEL - VEGETABLE OILS17 |
| 1.5. | MERITS AND DEMERITS OF VEGETABLE OILS AS C.I. ENGINE FUEL |
| 1.6. | PONGAMIA OIL ACTS AS C. I. ENGINE FUEL19 |
| 1.7. | BIODIESEL AS A C.I. FUEL21 |
| 1.8. | FUEL PROPERTIES OF SELECTED FUELS22 |
| 1.9. | ECONOMIC ROUND-UP OF BIODIESEL27 |
| 1.10. | ENGINE PERFORMANCE AND EMISSION PROBE27 |
| | |
| CHAP | TER 2: LITERATURE REVIEW AND |
| PROB | BLEM CONCEPTION30 |
| 2.1. | BIRD'S EYE VIEW OF BIODIESEL PRODUCTION31 |
| 2.2. | THE CHEMICAL STORY BEHIND THE BIRTH OF BIOFUEL 34 |
| 2.3. | EXPERIMENTAL STUDIES: BASIC APPROACH37 |
| 2.4. | LIMITATIONS FROM LITERATURE72 |
| 2.5. | PROBLEM FORMULATION74 |
| 2.6. | RESEARCH OBJECTIVES76 |
| | |
| _ | TER 3: MATERIALS AND METHOD TEGY78 |
| 3.1. | MATERIAIS 79 |

| 3.2. | TRANSESTERIFICATION - STANDARDIZATION PROCESS 79 |
|-------|--|
| 3.3. | DETERMINATION OF METHANOL QUANTITY FOR THE TRANSESTERIFICATION PROCESS OF PONGAMIA OIL81 |
| 3.4. | REGULATING STANDARD PARAMETERS INVOLVED IN METHYL TRANSESTERIFICATION PROCESS82 |
| 3.5. | DETERMINATION OF FUEL PROPERTIES84 |
| 3.6. | FTIR (FOURIER TRANSFORM INFRA-RED) ANALYSIS 105 |
| 3.7. | EVALUATION OF PERFORMANCE AND EXHAUST EMISSION PARAMETERS108 |
| 3.8. | ENGINE112 |
| 3.9. | INSTALLATION REQUIREMENTS FOR THE MACHINE114 |
| 3.10. | MEASUREMENT OF PARAMETER REGARDING ENGINE PERFORMANCE AND EXHAUST EMISSION118 |
| 3.11. | MEASUREMENTS OF EMISSIONS 120 |
| 3.12. | TGA/DTG ANALYSIS124 |
| 3.13. | GC- MS ANALYSIS OF PONGAMIA METHYL ESTER 129 |
| | |
| | TER 4: OUTCOME (RESULTS) AND JSSION131 |
| 4.1. | STANDARDIZATION OF TRANSESTERIFICATION PROCESS |
| | PARAMETERS FOR PONGAMIA METHYL ESTER 133 |
| 4.2. | FUEL CHARACTERIZATION148 |
| 4.3. | FTIR SPECTROSCOPY ANALYSIS155 |
| 4.4. | TGA/DTG ANALYSIS REPORT156 |
| 4.5. | GC-MS ANALYSIS |
| 4.6. | PERFORMANCE CHARACTERISTICS |
| 4.7. | EXHAUST EMISSION CHARACTERISTICS 165 |
| 4.8. | ECONOMIC ANALYSIS OF PONGAMIA BASED BIO-DIESEL 168 |
| 4.9. | REFLECTION |
| 4.10. | UNCERTAINTY IN MEASUREMENTS171 |

| CHAI | PTER 5: TAKE HOME P | OINTS AND EYE ON |
|------|----------------------|------------------|
| THE | FUTURE | 173 |
| 5.1. | KEY END NOTES | 173 |
| 5.2. | SCOPE OF FUTURE WORK | 177 |
| СНАІ | PTER 6: REFERENCES | 180 |