Dedication

To my colleagues, students and researchers.
Acknowledgement

First of all, giving thanks to Allah,
And a special thanks to supervisor

**DR. ALI MOHAMMED HAMDAN ADAM.**

I can’t forget giving thanks to everyone who helped me and gave me a new hope for successful.

I am gratefully acknowledges the financial support of the lectures and all the staff of Sudan University’s, School of Mechanical Engineering for all what they offered throughout my educational path in the university.

I wish to acknowledge the efforts of the Auto work shop staff for their standing beside me in the experimental work.

Also I would like to thanks the Africa city of technology to provide jatropha seeds, and I would like to thanks the Agricultural Engineering Department - College of Engineering - University of Khartoum to assistance in jatropha seeds processing, finally I would like to thanks Central Petroleum Laboratoriesto assistancein testing of fuel samplesphysical and chemical properties.

At the last “thanks” for every one stood beside me until the last dot.
Abstract

A finite-time thermodynamic modeling and simulation of irreversible Diesel cycle engines has been developed taking into account the variability of specific heats for working fluid due to temperature variation.

The effect of four different parameters on the engine was discussed, which are: the internal irreversibility, the heat losses, the friction losses and the cut-off ratio.

A program was developed by using MATLAB software to perform the necessary calculations of the thermodynamic model.

According to the results obtained, it was found that the results obtained from the thermodynamic model compared with the results obtained from experiments are convergent, and may be used in actual engine designs and applications.
تم تطوير نموذج محاكاة لمحرك يعمل وفقًا لدورة ديزل اللاوعوسية وذلك باستخدام طريقة الحركيات الحرارية محدودة الزمن مع الأخذ بعين الاعتبار التغير في قيم السعات الحرارية بالنسبة للمادة العاملة تبعًا للتغير في قيم درجات الحرارة.

أربع عوامل مختلفة تؤثر على المحرك تمت مناقشتها، وهي:

- اللاوعوسية الداخلية، فقد الحرارة، فقد الإحتراك ونسبة القطع.

تم استخدام برنامج ماتلاب لإجراء الحسابات اللازمة للنموذج. وفقاً للنتائج التي تم الحصول عليها تبين أن النتائج التي تم الحصول عليها من هذا النموذج مقارنة مع النتائج التي يتم الحصول عليها من التجارب العملية متقاربة وبالتالي يمكن استخدام هذه النتائج مستقبلاً في تصميم المحرك وتطبيقاته المختلفة.

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<tr>
<th>Symbol</th>
<th>Function</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B$</td>
<td>Heat leakage coefficient of the cylinder wall</td>
<td>kJ/kg.K</td>
</tr>
<tr>
<td>$C_p$</td>
<td>The constant pressure specific heat</td>
<td>kJ/kg.K</td>
</tr>
<tr>
<td>$C_v$</td>
<td>The constant volume specific heat</td>
<td>kJ/kg.K</td>
</tr>
<tr>
<td>$D$</td>
<td>The diffusion coefficient</td>
<td>m$^2$/s</td>
</tr>
<tr>
<td>$F_\mu$</td>
<td>The friction force</td>
<td>N</td>
</tr>
<tr>
<td>$\eta_I$</td>
<td>First law efficiency</td>
<td>%</td>
</tr>
<tr>
<td>$\eta_{II}$</td>
<td>Second law efficiency</td>
<td>%</td>
</tr>
<tr>
<td>$\eta_c$</td>
<td>Compression efficiency</td>
<td>%</td>
</tr>
<tr>
<td>$\eta_e$</td>
<td>Expansion efficiency</td>
<td>%</td>
</tr>
<tr>
<td>$\eta_{th}$</td>
<td>Thermal efficiency</td>
<td>%</td>
</tr>
<tr>
<td>$\eta_{th,rev}$</td>
<td>The maximum possible thermal efficiency</td>
<td>%</td>
</tr>
<tr>
<td>$I$</td>
<td>The flux of electric current</td>
<td>N.m$^2$/C</td>
</tr>
<tr>
<td>$J$</td>
<td>The diffusion flux</td>
<td>kmol/m$^2$.s</td>
</tr>
<tr>
<td>$K_H$</td>
<td>Finite heat conductance for source reservoir</td>
<td>kW/m.K</td>
</tr>
<tr>
<td>$K_L$</td>
<td>Finite heat conductance for sink reservoir</td>
<td>kW/m.K</td>
</tr>
<tr>
<td>$L$</td>
<td>Stroke length of the cylinder</td>
<td>m</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>The thermal conductivity</td>
<td>kW/m.K</td>
</tr>
<tr>
<td>$M_i$</td>
<td>The molecular weight for component $i$</td>
<td>kg/kmol</td>
</tr>
<tr>
<td>$\dot{m}$</td>
<td>The mass flow rate of working substance</td>
<td>kg/s</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Friction coefficient for global losses</td>
<td>N.s/m</td>
</tr>
<tr>
<td>$N$</td>
<td>The rotational speed of the engine</td>
<td>rev/sec</td>
</tr>
<tr>
<td>$P_\mu$</td>
<td>The friction power</td>
<td>kW</td>
</tr>
<tr>
<td>$P_{net}$</td>
<td>The net output power</td>
<td>kW</td>
</tr>
<tr>
<td>$q$</td>
<td>The heat flux</td>
<td>kW/m$^2$</td>
</tr>
<tr>
<td>$\dot{Q}_{add}$</td>
<td>The added heat flow-rate</td>
<td>kW</td>
</tr>
<tr>
<td>$\dot{Q}_{loss}$</td>
<td>The flow-rate of heat loss</td>
<td>kW</td>
</tr>
</tbody>
</table>
\( \dot{Q}_{\text{rej}} \) The rejected heat flow-rate \( \text{kW} \)

\( R \) The gas constant \( \text{kJ/kg.K} \)

\( R_u \) The universal gas constant \( \text{kJ/kg.K} \)

\( r_c \) The cut-off ratio

\( r_e \) The expansion ratio

\( r_v \) The compression ratio

\( \sigma_e \) The electric conductivity \( \text{kg} \)

\( T_1 \) Temperature of source thermal reservoir \( \text{K} \)

\( T_2 \) Temperature of sink thermal reservoir \( \text{K} \)

\( T_{iH} \) Internal high temperature for source reservoir \( \text{K} \)

\( T_{iL} \) Internal low temperature for sink reservoir \( \text{K} \)

\( T_H \) Temperature of source thermal reservoir \( \text{K} \)

\( T_L \) Temperature of sink thermal reservoir \( \text{K} \)

\( T_0 \) The average temperature of the working fluid and cylinder walls \( \text{K} \)

\( v \) Mean piston speed \( \text{m/s} \)

\( x \) Piston displacement \( \text{m} \)

\( x_i \) The mass fraction for component \( i \).
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