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LIST OF ABBREVIATIONS

A/F	Air-fuel ratio
BMEP	Brake mean effective pressure
BOI	Board of investment
BSFC	Brake specific fuel consumption
BSEC	Brake specific energy consumption
BTDC	Before top dead center
BTE	Brake thermal efficiency
BTU	British thermal unit
COV	Coefficient of variation
CR	Compression ratio
DI	Direct injection
FC	Fixed carbon
HC	Hydrocarbon
HHV	High heating value
IC	Internal combustion
IVC	Intake valve close
IVO	Intake valve open
LFG	Landfill gas
MBT	Maximum brake torque
SI	Spark ignition
TDC	Top dead center
VM	Volatile matter

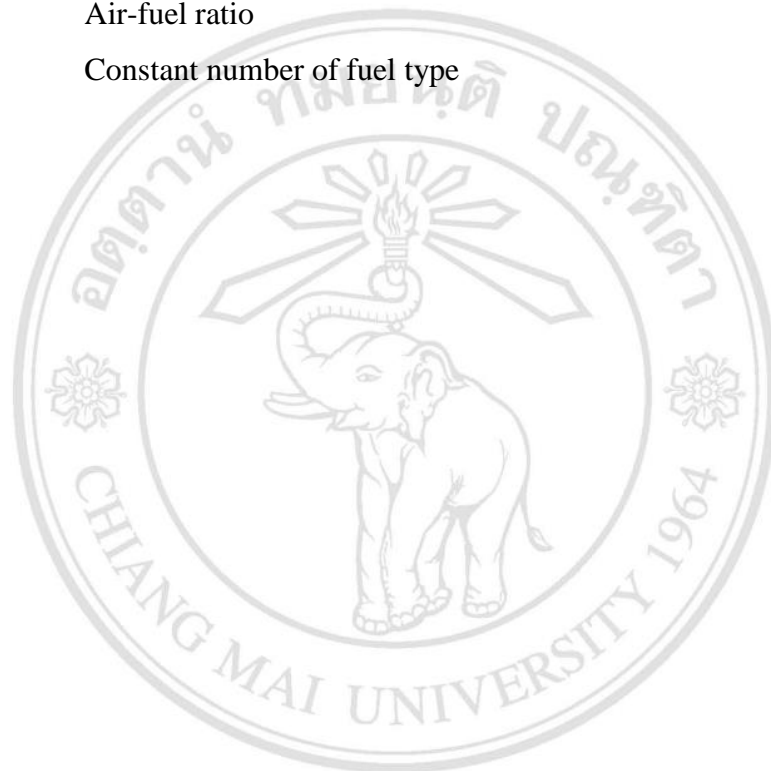
LIST OF SYMBOLS

A	Cylinder surface area (m^2)
a	Crank radius (m)
$BSFC$	Brake specific fuel consumption (kg/kWh)
$BSEC$	Brake specific energy consumption (MJ/kWh)
BTE	Brake thermal efficiency (%)
B_m	Constant number of fuel type (cm/s)
B_2	Constant number of fuel type (cm/s)
b	Bore cylinder (m)
$bmep$	Brake mean effective pressure (kPa)
C_p	Specific heat at constant pressure (kJ/kg-K)
C_v	Specific heat at constant volume (kJ/kg-K)
C_{pm}	Specific heat of gas at constant pressure (kJ/kg-K)
C_{vm}	Specific heat of gas at constant volume (kJ/kg-K)
C_{pi}	Specific heat of gas species at constant pressure (kJ/kg-K)
$C_{p_{CO}}$	Specific heat of carbon monoxide at constant pressure (kJ/kg-K)
$C_{p_{H_2}}$	Specific heat of hydrogen at constant pressure (kJ/kg-K)
$C_{p_{CH_4}}$	Specific heat of methane at constant pressure (kJ/kg-K)
$C_{p_{O_2}}$	Specific heat of oxygen at constant pressure (kJ/kg-K)
$C_{p_{CO_2}}$	Specific heat of carbon dioxide at constant pressure (kJ/kg-K)
$C_{p_{N_2}}$	Specific heat of nitrogen at constant pressure (kJ/kg-K)
D_{iv}	Intake valve diameter (m)
$f(\theta)$	Wiebe function
f_{mep}	Friction on engine work (kPa)
f_{mep_1}	Bearing friction (kPa)
f_{mep_2}	Piston and ring friction (kPa)
f_{mep_3}	Wall tension ring friction (kPa)
f_{mep_4}	Valve gear friction (kPa)

f_{mep_5}	Pumping loss (kPa)
f_{mep_6}	Combustion chamber and wall pumping loss (kPa)
G	Number of intake valve per cylinder
h_i	Enthalpy flux (kJ/kg)
HV	Mean calorific value of gas (MJ/Nm ³)
HV_{pg}	Mean calorific value of producer gas (MJ/Nm ³)
h	Heat transfer coefficient (W/m ² -K)
imp	Indicate mean pressure (kPa)
k	Specific heat ratio
k_{int}	Initial specific heat ratio
k_{new}	Final specific heat ratio
k_m	Specific heat ratio of gas
LHV_{Di}	Lower heating value of diesel (MJ/kg)
l	Connecting rod (m)
M_i	Molar mass of gas species (kg/kmol)
M_m	Molecular mass (kg/kmol)
m_i	Mass specific enthalpy flow (kg)
m_{fi}	Mole fraction
m'	Flow rate of producer gas in SI engine (m ³ /s)
m_b	Biomass consumption (kg/h)
m_f	Diesel consumption (kg/h)
N	Engine speed (rpm)
n	Amount of gas component
n_p	Number of piston ring
P	Pressure cylinder (kPa)
P_b	Brake power (W)
P_{Qin}	Pressure from heat input (kPa)
P_{Qloss}	Pressure from heat loss (kPa)
P_s	Piston skirt length (m)
P_0	Reference pressure (kPa)

P_1	Initial pressure (kPa)
P_2	Pressure at compression process (kPa)
P_3	Pressure at combustion process (kPa)
Q	Heat release (kJ)
Q_{in}	Heat input (W)
Q_{loss}	Heat loss (W)
R_i	Average gas constant of gas species (J/kg-K)
R_m	Average gas constant (J/kg-K)
R_u	Universal gas constant (J/mole-K)
r_c	Compression ratio
S_i	Piston speed (cm/s)
S_L	Laminar burning velocity (cm/s)
$S_{L,0}$	Laminar burning velocity reference (cm/s)
s	Stroke (m)
T	Temperature (K)
T_{avg}	Average gas temperature (K)
T_b	Brake torque (Nm)
T_g	Gas temperature in cylinder (K)
T_w	Cylinder wall temperature (K)
T_0	Reference temperature (K)
T_1	Initial temperature (K)
T_2	Temperature at compression process (K)
T_3	Temperature at combustion process (K)
U	Internal energy (kJ)
V	Cylinder volume (m ³)
V_d	Displacement volume (m ³)
V_{pg}	Producer gas flow rate (m ³ /s)
W	Work (kJ)
y_i	Mole fraction of gas
Y_M	Mass fraction of diluent present in the air mixture

β	Function of the equivalence ratio
γ	Function of the equivalence ratio
θ	Crank angle (Degree)
θ_0	Start of heat release angle (Degree)
$\Delta\theta$	Duration of heat release (Degree)
τ	Torque (Nm)
ϕ	Air-fuel ratio
ϕ_m	Constant number of fuel type



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ข้อความแห่งการริเริ่ม

เครื่องยนต์ก๊าซโปรคิวเซอร์ที่มีอยู่ในปัจจุบันส่วนใหญ่สมรรถนะเครื่องยนต์ค่อนข้างต่ำโดยเฉพาะกำลังเครื่องยนต์ ประสิทธิภาพความร้อนและมลพิษไอเสีย การศึกษาในส่วนของการดัดแปลงเครื่องยนต์สันดาปภายในเพื่อให้สามารถใช้ก๊าซโปรคิวเซอร์เป็นเชื้อเพลิงและการทดสอบสมรรถนะเครื่องยนต์จึงมีความสำคัญและมีความจำเป็นอย่างยิ่งต่อการพัฒนาเครื่องยนต์สันดาปภายในในอนาคต ในงานวิจัยนี้ได้ศึกษาสมรรถนะเครื่องยนต์ก๊าซโปรคิวเซอร์ในสภาวะอัตราส่วนการอัดสูง (>14) ประกอบกับงานวิจัยที่เกี่ยวข้องกับเครื่องยนต์เล็กก่อนข้างขาดแคลน องค์ความรู้ใหม่ที่ได้จากงานวิจัยนี้ประกอบด้วย

1. ผลการวิจัยที่ครอบคลุมในการประยุกต์ใช้ก๊าซโปรคิวเซอร์กับเครื่องยนต์การเกษตรขนาดเล็กรูปแบบจุดระเบิดด้วยประกายไฟภายใต้อัตราส่วนการอัดที่สูง
2. ผลการศึกษาพารามิเตอร์ที่สำคัญคืออัตราส่วนการอัด การออกแบบห้องเผาไหม้และระยะเวลาจุดระเบิดที่ส่งผลต่อสมรรถนะเครื่องยนต์ก๊าซโปรคิวเซอร์
3. การประยุกต์ใช้แบบจำลองทางคณิตศาสตร์ของเครื่องยนต์สันดาปภายในสำหรับการทำนายสมรรถนะเครื่องยนต์ก๊าซโปรคิวเซอร์ภายใต้อัตราส่วนการอัดที่สูง

ข้าพเจ้าขอรับรองว่าวิทยานิพนธ์ของข้าพเจ้าไม่ละเมิดลิขสิทธิ์ของผู้อื่นหรือละเมิดกรรมสิทธิ์ใดๆ นอกจากนี้งานวิจัยนี้ยังไม่เคยถูกส่งเพื่อขอรับปริญญาในมหาวิทยาลัยนี้และมหาวิทยาลัยอื่น

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STATEMENT OF ORIGINALITY

Existing producer gas engines at present are mostly of low performance with regards to power output, thermal efficiency and emission. The study of modification and experiment on existing internal combustion engine to operate with producer gas are important and there are needs to develop an internal combustion engine further. Investigations on relatively high compression ratio (>14) for producer gas engine as well as research on small gas engine are rather scarce. Novel and major contributions from this work include:

1. Extensive experimental campaign on application of producer gas to small agricultural engines with high CR in SI mode.
2. Parametric investigation of CR, combustion chamber design, and spark timing on performance of producer gas engines.
3. Application of mathematical model of an IC engine in predicting producer gas engine performance at high CR.

I hereby certify that, my thesis does not infringe upon anyone's copyright nor violate an proprietary rights. Furthermore, this work has not been submitted for a degree at this or any other university

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