Chapter Two

Literature Review

2.1. INTRODUCTION

In 1996, Badescu and Andresen proposedthat finite-time thermodynamics (F.T.T.) can becomplemented with some probabilistic conceptsallowing a more accurate description of theperformance indicators of a power system. Theseauthors studied a continuous flow tube reactor whichsupplies heat to an engine from a chemical reactionwith linear kinetics. In general, typical FTT-modelsof thermal cycles are worked in steady state and onlyone cycle is taken as representative of all the othercycles pertaining to a sequence of them. In a typicalinternal combustion engine, several thousands ofcycles are performed in a minute and there existtheoretical and experimental reasons to expectimportant variations from one cycle to the next.

2.2. HISTORICAL BACKGROUND

Finite-time thermodynamics was 'invented' in 1975 by R. S. Berry, P. Salamon, and B. Andersen as a consequence ofthe first world oil crisis. It simply dawned on us that all the existing criteria of merit were based on reversibleprocesses and therefore were totally unrealistic for most real processes. That made an evaluation of the potentialfor improvement, of minimizing the losses, for a given process quite difficult.

Finite-time thermodynamics is coming of age. A child ofthe 1973 oil crisis, it was conceived in 1975, and the firstpublication on this topic appeared in 1977.

2.3. LITERATURE REVIEW

M. Mozurkewich and R. S. Berry (1981) have used the methods of finite time thermodynamics to find the optimal time path of an Otto cycle with frictionand heat leakage. Optimality is defined by maximization of thework per cycle; the system is constrained to operate at a fixed frequency,so the maximum power-is obtained. The result is an improvementof about 10% in the effectiveness (second-law efficiency)of a conventional near-sinusoidal engine.

Xiaoyong Qin*et al* (2003) have studied the performance of irreversible reciprocating heat engine cycles withheat transfer loss and friction-like term loss is analyzed using finite-timethermodynamics. They have derived the universal relations between the power output and thecompression ratio, between the thermal efficiency and the compression ratio,and the optimal relation between power output and the efficiency of the cycles. Moreover, analysis and optimization of the model were carriedout in order to investigate the effect of cycle processes on the performance ofthe cycle using numerical examples. The results obtained herein include theperformance characteristics of irreversible reciprocatingDiesel, Otto, Atkinson and Brayton cycles.

P. C. Roy (2008) has develop a finite-time thermodynamic modeling and simulation of irreversible Diesel cycle enginesconsidering non-linear variable specific heats with temperature, heat transfer loss, internalirreversibility effects and engine friction loss. A parametric study on performance characteristics such as powerand efficiency have been made and discussed which may be used in actual engine designs and applications. Finally he has analyzes and discuss the effect of engine speed, heat transfer loss, and internal irreversibility with respect to compression ratio on powerand cycle efficiency.

GE, Y., *et al*(2010) have analyzed performance of an air-standard Atkinson cycle by using finite-time thermodynamics. The irreversible cycle model which is more close to practice isfounded. They have choose model considering non-linear variable specific heats with temperature, heat transfer loss, internalirreversibility effects and engine friction loss, the friction loss computed according to the mean velocity of the piston, they have derived the universal relations between the power output and thecompression ratio, between the thermal efficiency and the compression ratio,and the optimal relation between power output and the efficiency of the cycles. Moreover, analysis and optimization of the model were carriedout in order to investigate the effect of cycle processes on the performance ofthe cycle using numerical examples. The results obtained in this paper by saying may provide guide lines for the design of practical internal combustion engines operating on Atkinson cycle.

NegarAsghari, *et al* (2013) have analyzed performance of an air-standard Diesel cycle by using finite-time thermodynamics along with determination of constant volume specific heat. The latter parameter has been determined as a function of temperature and compression ratio. Both output power and thermal efficiency at different cutoff ratios have been taken into consideration. The results show that, the power initially increased fast and reached to a maximum value at each cutoff ratio, followed by decreased with a slower rate and reached to a minimum value at each cutoff ratio. The maximum power was larger for smaller cutoff ratio. The maximum power and thermal efficiency were obtained 4.51 kW (for cutoff 1.3) and 0.61 (for cutoff ratio 1.5), respectively under reversible condition. The results can be used to design a real diesel with a high thermal efficiency and power.

A. Sakhreih*et al* (2010) have established a mathematical model of the miniature diesel engine which the working fluid is a mixture of gases, and compared the results with those obtained when using the air as a working fluid with variable specific heat, and have studied most of the important properties for compression ignition engine, such as equivalence ratio, engine speed, maximum temperature, gas pressure, brake mean effective pressure and cycle thermal efficiency, also have studied the effect of boost pressure on both models and found that in the model, which uses air as working fluid maximum pressure and maximum temperature greater than it is in a model which is used gas mixture as a working fluid.

Rahim Ebrahimi (2009) has used Finite-time thermodynamics method to analyze the air-standard internal-combustion Diesel cycle. He has derived the relations between the power output and the compression ratio between the power output and thethermal efficiency. Also he has found the maximum net power output and the corresponding efficiency limit of the cyclewith friction losses, and he gives a detailed numerical examples.

Reza Masoudi(2012) formulated models for the Otto cycle and cycle Diesel cycle,taking into account the change in the specific heat of the working fluid, considering the volatility in the properties of the working fluid in two ways, the fluctuations considered are of the uncorrelated type (uniform and gaussian) and one correlated case (logistic map distribution). He found that in the correlated fluctuations case, the power output and the efficiency of both cycles reach bigger fluctuations than in the uncorrelated cases.

CHEN. L. *et al* (2008) analyzed the performance of an air-standard reciprocating Brayton cycle with heat transfer loss and variable specific heats of working fluidby using finite-time thermodynamics, they are derived the relations between the work output and the compression ratio, between the thermal efficiency and the compression ratio, as well as the optimal relation between work output and the efficiency of the cycle by detailed numerical examples, they are analyzed the effects of heat transfer loss and variable specific heats of working fluid on the cycle performance. They have concluded that the effect ofheat transfer loss and variable specific heats of working fluid on the cycle performance are obvious, and they should be considered in practice cycle analysis.