Chapter Five

Results and Discussion

5.1. INTRODUCTION

In this chapter we will display the results that obtained from the program for various parameters variability, such as effect of non-linear variable specific heats, effect of internal irreversibility,. Also we will discuss these results and compare with similar results that obtained in previous studies.

5.2. THERMODYNAMIC MODEL INPUT DATA DETAILES

For this model we will assume the technical and thermodynamic engine specifications shown in table 5.1

Table 5.1: The technical and thermodynamic engine specifications

Inlet air temperature (T_1)	288K
Pressure ratio (r_p)	Vary from 2 to 30 with increment 1
Universal Gas constant (R_U)	8.3145 kJ/kg.K
Compressor efficiency (η_c)	Three values: 0.7, 0.8 and 0.9
Turbine efficiency (η_e)	Three values: 0.7, 0.8 and 0.9
Fuel mass flow rate ($\dot{m}_f$)	0.016123kg/s
Gas constant for air (R)	0.2883 kJ/kg.K
Air mass flow rate ($\dot{m}_a$)	1kg/s
Theoretical air	400%

Depending on the data above, we will performmodel calculations and presenting results according to the effect of each parameters mentioned above as shown in the following point.

5.3. EFFECT OF INTERNAL IRREVERSIBILITY

In this section we will discuss the effect of internal irreversibility of the engine performance parameters at variable pressure ratio and without the presence of friction loss and heat loss,

Fig. 5.1Show the compressor power ($\dot{W}_C$) against pressure ratio (r_p) for 3 different values of compressor isentropic efficiencies.

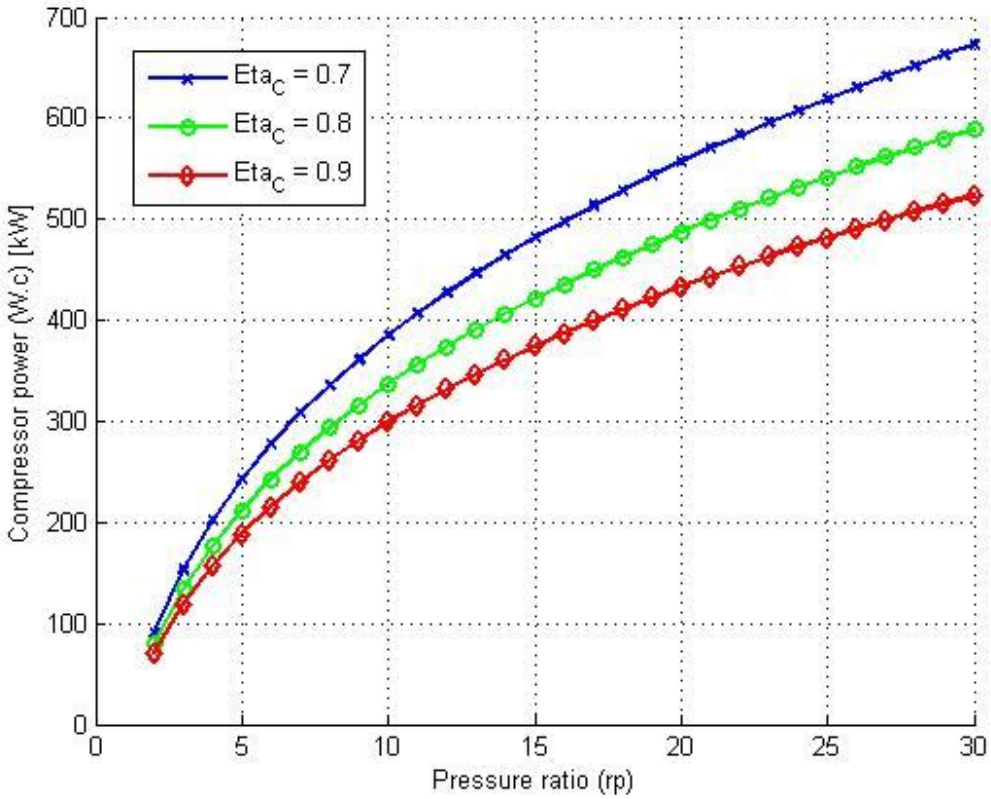

Fig. 5.1: Effect of internal irreversibility on compressor power ($\dot{W}_C$)

From fig. 5.1 it's clear that the relation between compressorisentropic efficiency andcompressor power is inversely, the compressor power corresponding to the pressure ratio values approximately from 2 to 7 increases rapidly for all value of isentropic compressor efficiency,but for that values corresponding to the pressure ratio value above 7 approximately increasing slightly.

Fig. 5.2 Show the compressor power ($\dot{W}_T$) against pressure ratio (r_p) for 3 different values of turbine isentropic efficiencies

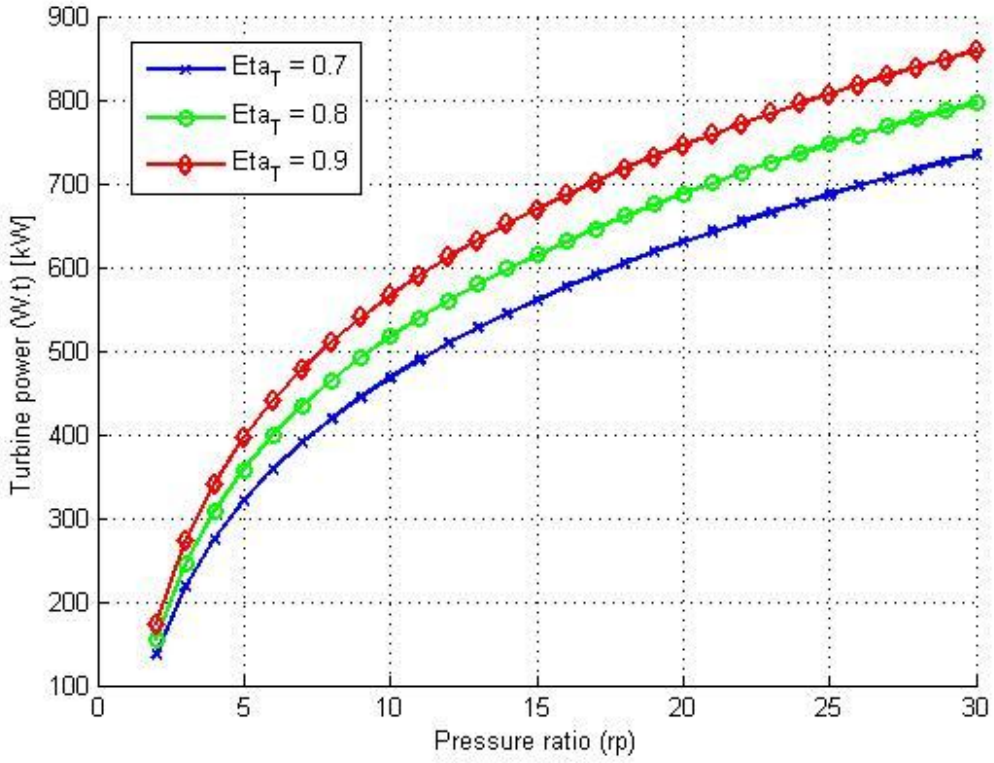

Fig. 5.2Effect of internal irreversibility on turbine power ($\dot{W}_T$)

From fig. 5.2 it's clear that the relation between turbine isentropic efficiency andturbine power is proportional,the turbine power corresponding to the pressure ratio values approximately from 2 to 10 increases rapidly for all value of isentropic turbine efficiency, but for that values corresponding to the pressure value above 10 approximately increasing slightly.

Fig. 5.3 Show the net power output ($\dot{W}_{net}$) against pressure ratio (r_p)and for 3 different values of compressor and turbine efficiencies.

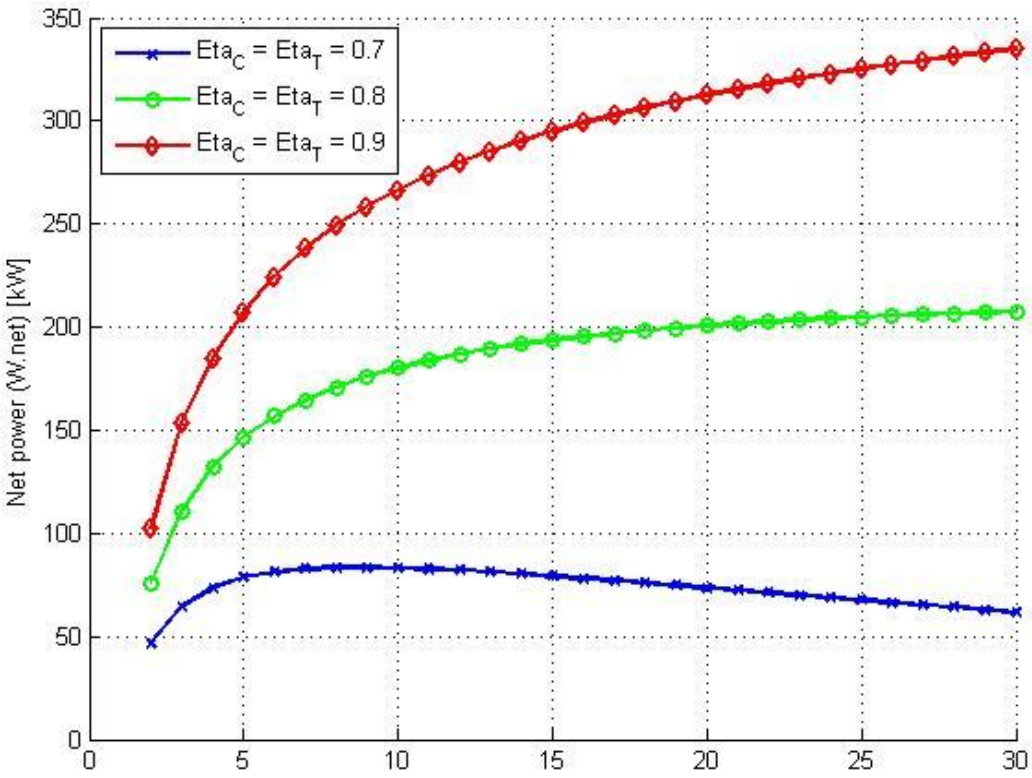

Fig. 5.3: Effect of internal irreversibility on the net power ($\dot{W}_{net}$)

From fig. 5.3 it's clear that the relation between net power output and pressure ratio is directly proportional to some extent. For isentropic efficiency equal 0.7 the net power corresponding to the pressure ratio values approximately from 2 to 10 increases and after that the value is decrease rapidly for all value of isentropic efficiency. For isentropic efficiency equal 0.8 the net power corresponding to the pressure ratio values approximately from 2 to 15 increasesrapidlyand after that the value is increase slightly. For isentropic efficiency equal 0.9 the net power corresponding to the pressure ratio values approximately from 2 to 30 increases rapidly.

Fig. 5.4 Show the specific fuel consumption (S. F. C.) against pressure ratio (r_p) for 3 different values of compressor and turbine efficiencies.

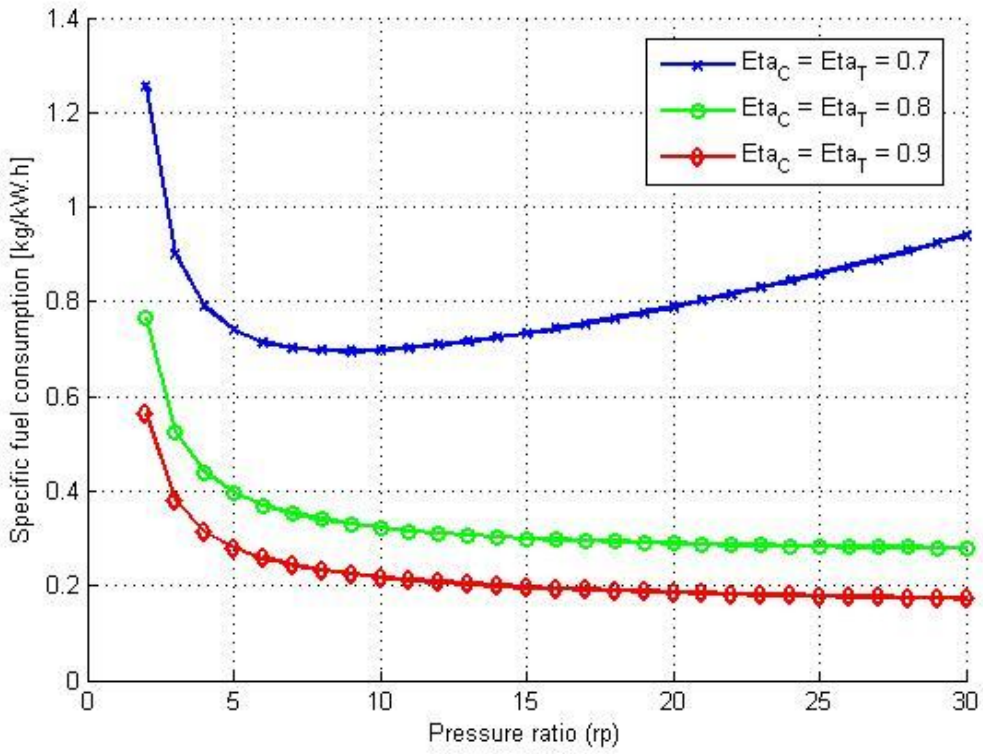

Fig. 5.4: Effect of internal irreversibility on specific fuel consumption

From fig. 5.4 it's clear that the relation between specific fuel consumption **(**$S.F.C.$**)** and pressure ratio (r_p) is decrease corresponding to the pressure ratio value approximately equal 0.9, but for isentropic efficiency equal 0.7 after that increase. for isentropic efficiency equal 0.8 the specific fuel consumption is decrease slightly. for isentropic efficiency equal 0.9 the specific fuel consumption decrease rapidly. Because the specific fuel consumption depend on net power output.

Fig. 5.5 Show the actual cycle efficiency $(\eta_{Act,})$ against pressure ratio $(r_p)$and for 3 different values of isentropic efficiency for compressor and turbine.

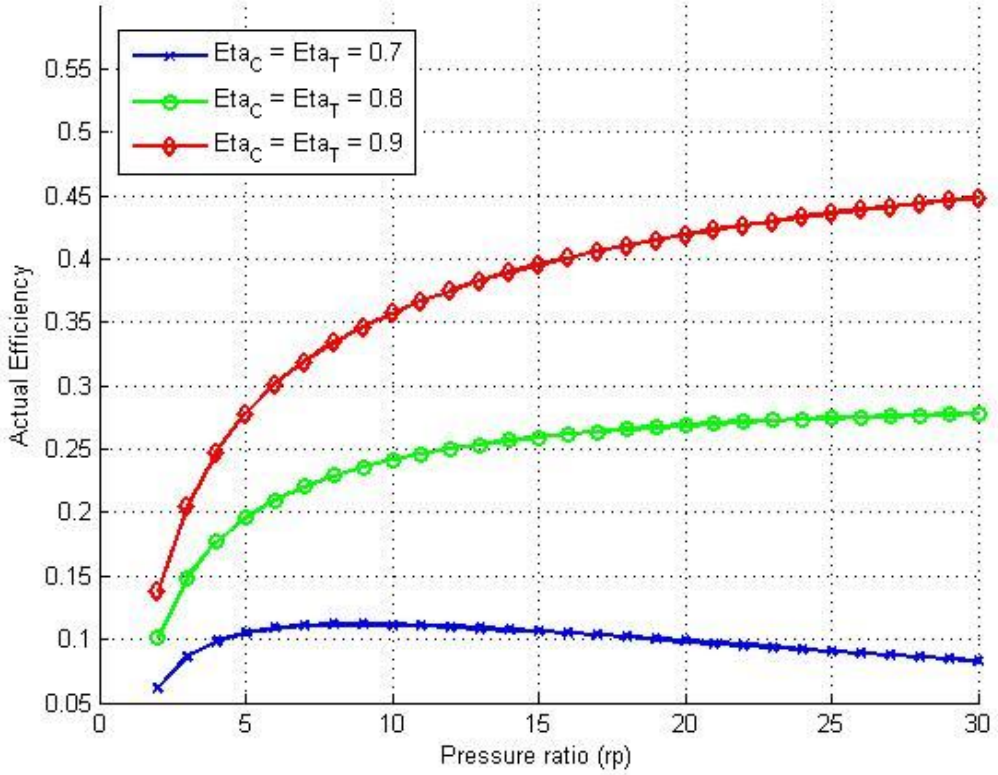

Fig. 5.5: Effect of internal irreversibility on actual efficiency (η_{Act}).

From fig. 5.5 it's clear that the relation between actual efficiency (η_{Act}) and pressure ratio (r_p) is increase corresponding to the pressure ratio 11approximately, but for isentropic efficiency equal 0.7 after that decrease rapidly. for isentropic efficiency equal 0.8 the actual efficiency is increase slightly. for isentropic efficiency equal 0.9 the actual efficiency increase rapidly. Also the actual efficiency depends on net power output.

Fig. 5.7 Show the efficiencies ($\eta_{Act}, \eta_{Nov}, \eta_{Car}$) against pressure ratio (r_p) for isentropic efficiency of compressor and turbine is 0.7.

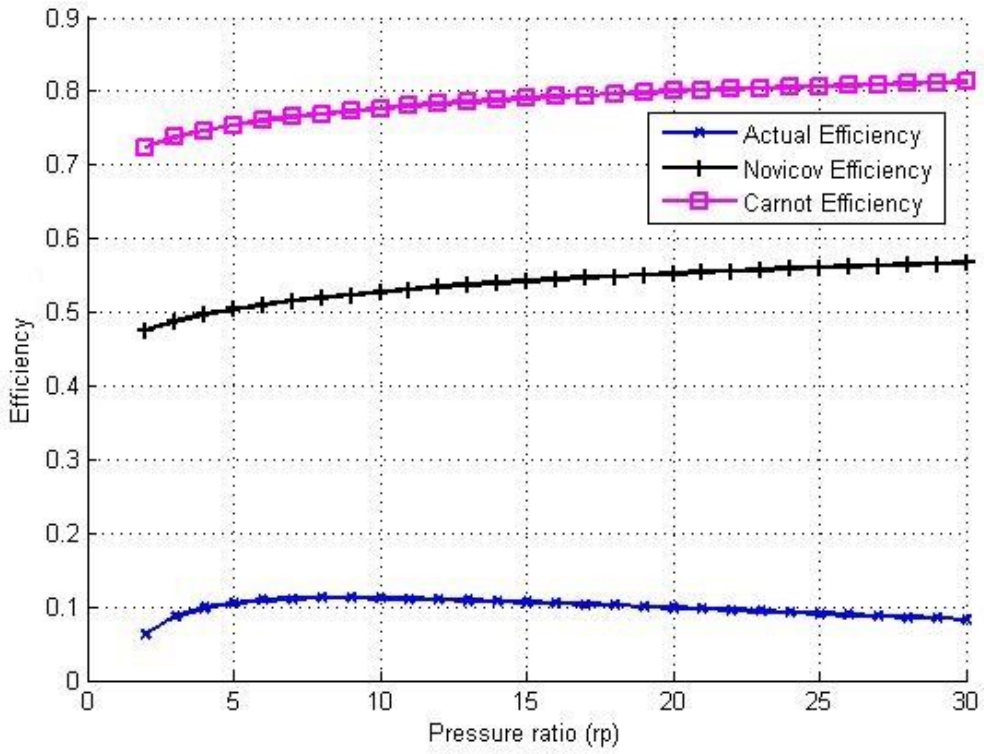

Fig. 5.6: Effect of internal irreversibility on three type of efficiencies ($\eta_{Act}, \eta_{Nov}, \eta_{Car}$,) for isentropic efficiency 0.7.

From fig. 5.6 it's clear that the relation between three types of efficiencies and pressure ratio (r_p) is increase corresponding to the pressure ratio 10 approximately, but in curve actual efficiency after that decrease slightly. And curve Novicov efficiency and Carnot efficiency continue increase rapidly.The actual efficiency corresponding to the net power output, the different between Novicov efficiency and Carnot efficiency approximately 50% and 70% respectively.

Fig. 5.7 Show the efficiencies ($\eta_{Act}, \eta_{Nov}, \eta_{Car}$) against pressure ratio (r_p) for isentropic efficiency of compressor and turbine is 0.8.

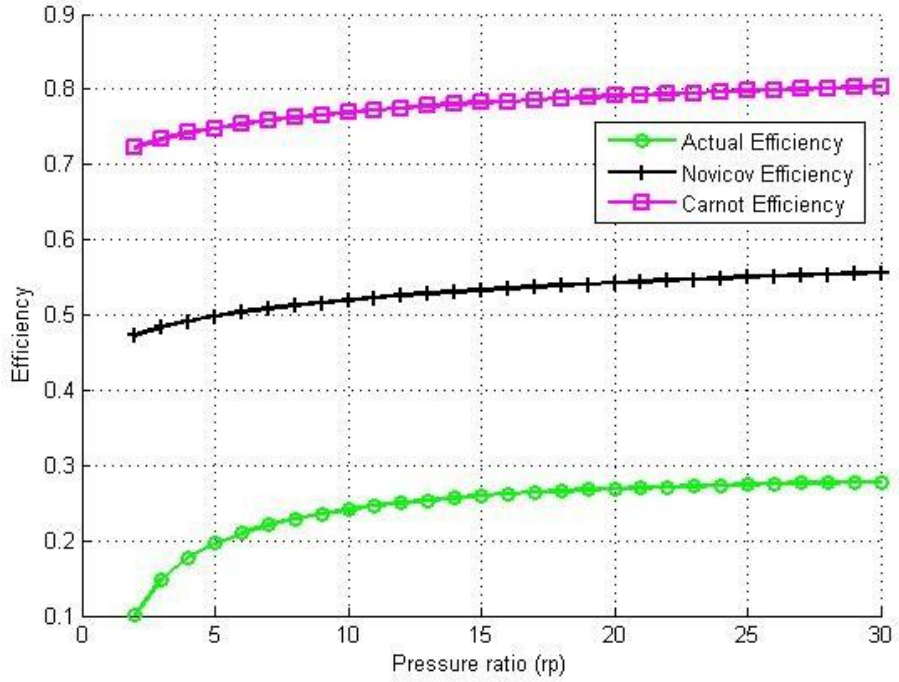

Fig. 5.7:Effect of internal irreversibility on three type of efficiencies ($\eta_{Act,}\eta_{Nov,}\eta_{Car,}$) for isentropic efficiency 0.8.

From fig. 5.7 it's clear that the relation between three types of efficiencies and pressure ratio (r_p) is increase corresponding to the pressure ratio. but the increase in all curves after pressure ratio equal 15 continue increase but slightly, the different between actual efficiency,Novicov efficiency and Carnot efficiency approximately 28% and 50% respectively.

Fig. 5.8 Show the efficiencies ($\eta_{Act,}\eta_{Nov,}\eta_{Car,}$) against pressure ratio (r_p) for isentropic efficiency of compressor and turbine value is 0.9.

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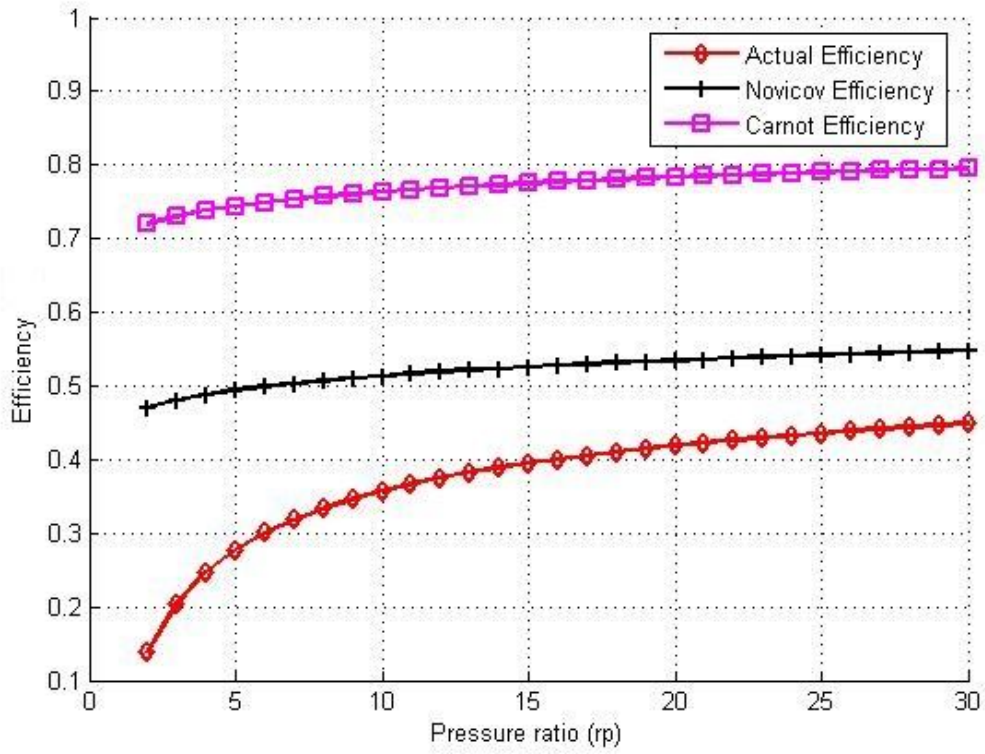

Fig. 5.8:Effect of internal irreversibility on three type of efficiencies ($\eta_{Act}, \eta_{Nov}, \eta_{Car}$) for isentropic efficiency 0.9.

From fig. 5.8 it's clear that the relation between three types of efficiencies and pressure ratio (r_p) is increase corresponding to the pressure ratio. but the increase in curve of actual efficiency after pressure ratio equal 15 continue increase but rapidly because the net power output is increased, and in curves Novicov efficiency and Carnot efficiency after pressure ratio equal 15 continue increase but slightly, the different between actual efficiency,Novicov efficiency and Carnot efficiency approximately 10% and 35% respectively.