FOR STUDENTS

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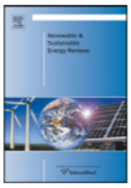

Coefficient of performance (COP) analysis of geothermal district heating systems (GDHSs): Salihli GDHS case study

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COP
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ABSTRACT

The purpose of this survey is about to analyze the heating coefficient of performance (COP) of geothermal district heating systems. Actual system data are taken from the Salihli GDHS, Turkey. The collected data are quantified and illustrated in tables, particularly for a reference temperature for comparison purposes. In this study, firstly energy and COP analysis of the GDHSs is introduced and then Salihli GDHS coefficient of performance results is given as a case study. Moreover, this paper offers an interesting empirical study of certain geothermal systems.

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A review on the experimental and analytical analysis of earth to air heat exchanger (EAHE) systems in Turkey

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ABSTRACT

During the last three decades, a number of studies have been conducted by various investigators in the design, modeling and testing of earth to air heat exchanger (EAHE) systems. This paper reviews the studies conducted on the experimental and analytical analysis of EAHE systems in Turkey and around the world as of the end February 2011. The studies undertaken on the EAHE systems are categorized into two groups as follows: (i) open loop for space heating/cooling and (ii) closed loop for space heating/cooling systems. This paper investigates the studies on EAHEs, also known underground air tunnel systems.

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Investigation of wind energy potential of Muradiye in Manisa, Turkey

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Wind
Wind energy
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ABSTRACT

The purpose of this survey is about to investigate wind energy potential of Celal Bayar University Muradiye Campus. The experimental system was commissioned in November 2006 and performance monitoring tests have been conducted since then. Author also undertake a case study to investigate how varying wind speeds considered affect the electricity production of the wind turbine system and to estimate a capacity factor which is defined as the ratio of the average power output to the rated output power of the generator. The collected data are quantified and illustrated in the tables, 07th of November 2006 till 09st of December 2007 for comparison purposes. According to experimental studies between 2006 and 2007 years, yearly average wind velocity is found to be 3.21 m/s at 30 m height and capacity factor is estimated to be 14.1% for Enercon E48 (800 kW) wind turbine. According to these results, the mean wind speed does not provide economical electricity production from the wind energy.

Exergoeconomic analysis of small industrial pasta drying systems

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Abstract: In the current study, author performs an exergoeconomic analysis of an industrial pasta final drying process. The relations between capital costs and thermodynamic losses for the devices in the system are investigated. Thermodynamic loss rate-to-capital cost ratios are used to show that, for the devices and the overall system, a systematic correlation appears to exist between capital cost and exergy loss (total or internal), but not between capital cost and energy loss or external exergy loss. This correlation may imply that devices in a successful industrial pasta drying system is configured so as to achieve an overall optimal design, by appropriately balancing the thermodynamic (energy- and exergy-based) and economic (cost) characteristics of the overall system. Thermodynamic loss rate to capital cost values R_{en} and R_{ex} are obtained as 0.016–0.004, while total energy rate input value to system change between 304.85 and 316.25 kW. Energetic and exergetic efficiencies of the system processes are determined in an attempt to assess their individual performances. The energy and exergy efficiencies of the overall system are found to be as 72.1 and 65.4 per cent, respectively.

Keywords: drying, efficiency, energy, exergy, thermo-economic analysis

Renewable and Sustainable Energy Reviews 46 (2015) 210–217

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Modeling of driveway as a solar collector for improving efficiency of solar assisted geothermal heat pump system: a case study

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Energy efficiency
Energy saving
Geothermal energy
Heat pump
Renewable energy

ABSTRACT

It is well known that rooftop solar thermal panels increase both power rates of circulation pumps and initial investment cost of solar assisted ground source (geothermal) systems. To avoid both of them it means that the unnecessary energy consumption rates of circulation pump(s) and their initial capital cost, rather than installing rooftop solar thermal panels, driveways can be used as solar collectors for improving efficiency of geothermal heat pump systems (GSHP) and declining initial capital cost of SAGSHPs. Mainly this idea was first put in the middle by Jefferson W. Tester. In this paper, we will examine modeling of driveway as solar thermal panel to enhance efficiency of solar assisted geothermal heat pump system (SAGSHP) depends on its different operating types; yet we will give only a case that is investigated theoretically for solar assisted geothermal heat pump systems.

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Energy and exergy analysis of electricity generation from natural gas pressure reducing stations

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Efficiency
Energy
Energy conversion
Energy recovery
Exergy
Natural gas

ABSTRACT

Electricity generation or power recovery through pressure reduction stations (PRS) for general use has not been realized in Izmir. The main objective of the present study was to do a case study for calculating electricity to be recovered in one natural gas pressure reduction stations in Izmir. It is the first forecasting study to obtain energy from natural gas pressure-reducing stations in Izmir. Energy can be obtained from natural gas PRS with turbo-expanders instead of using throttle valves or regulators from the PRS. The exergy performance of PRS with TE is evaluated in this study. Exergetic efficiencies of the system and components are determined to assess their individual performances. Based upon pressure change and volumetric flow rate, it can be obtained by recovering average estimated installed capacity and annual energy 494.24 kW, 4113.03 MW h, respectively. In terms of estimated installed capacity power and annual energy, the highest level is 764.88 kW, approximately 6365.34 MW h, in Aliaga PRS. Also it can be seen that CO_2 emission factor average value is 295.45 kg/MW h.

International Journal of Heat and Mass Transfer

journal homepage: www.elsevier.com/locate/ijhmt

A practical approach to predict soil temperature variations for geothermal (ground) heat exchangers applications

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Earth to air heat exchanger
Energy efficiency
Energy saving
Geothermal energy

ABSTRACT

The paper aims at improving a model predicting daily soil temperatures depending on depth and time. The thermal behavior of the ground (near the surface) as a function of depth and time is difficult to simulate from one point since there are many parameters such as short term weather variations, seasonal variations, moisture content of soil, and thermal conductivity of soil etc. affecting on the temperature of ground. The main drawback of this manuscript is that it claims that the improved model will provide the researchers with easily accessible predictions of daily soil temperature variations, which were modeled from daily fluctuations in air temperatures using a sinusoidal function of time and depth. Transient heat flow principles were used with assumptions of one dimensional heat flow, homogeneous soil, and constant thermal diffusivity. Measured and predicted soil temperatures at depths 5 cm, 10 cm, 20 cm and 300 cm were compared with experimental field results to validate the accuracy of the current model. For an annual cycle; at depth 5 cm, 10 cm, 20 cm, and 300 cm the average maximum percentage of errors were 10.78%, 10%, 10.26%, and 14.95%, respectively. Soil temperature measurements at 3 m depth were made on the earth to air heat exchanger system (EAHE) installed in the Solar Energy Institute in Ege University, Bornova, Izmir. Daily average soil temperatures at depths 5 cm, 10 cm, and 20 cm were taken from Izmir State Meteorological Station. Finally, we analyzed solar fluctuations on soil temperature as a function of depth from 5 cm to 300 cm, and time, gave soil temperature as a function of time up to 1 year (8760 h) for the following depths $z = 50$ cm, 100 cm, 300 cm, 500 cm, and 1000 cm.

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Experimental prediction of total thermal resistance of a closed loop EAHE for greenhouse cooling system ☆

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Keywords:
EAHE
Geothermal energy
Renewables

ABSTRACT

The design of an earth to air heat exchanger (EAHE) requires knowledge of its total thermal resistance (R_{Tot}) for heating and cooling applications. In this research, a 47 m long horizontal, 56 cm nominal diameter U-bend buried galvanized was studied experimental EAHE used for the determination and evaluation of thermal properties of heat exchanger. This system was designed and installed in the Solar Energy Institute, Ege University, Izmir, Turkey. Based on the experimental results, generalized relationships were developed for predicting of thermal resistance of the heat exchanger. Average total heat exchanger thermal resistance was estimated to be 0.021 K-m/W as a constant value under steady state condition.

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Exergy and reliability analysis of wind turbine systems: A case study

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Abstract

The present study undertakes an exergy and reliability analysis of wind turbine systems and applies to a local one in Turkey: the exergy performance and reliability of the small wind turbine generator have been evaluated in a demonstration (1.5 kW) in Solar Energy Institute of Ege University (latitude 38.24 N, longitude 27.50 E), Izmir, Turkey. In order to extract the maximum possible power, it is important that the blades of small wind turbines start rotating at the lowest possible wind speed. The starting performance of a three-bladed, 3 m diameter horizontal axis wind turbine was measured in field tests. The average technical availability, real availability, capacity factor and exergy efficiency value have been analyzed from September 2002 to November 2003 and they are found to be 94.20%, 51.67%, 11.58%, and 0–48.72%, respectively. The reliability analysis has also been done for the small wind turbine generator. The failure rate is high to an extent of $2.28 \times 10^{-4}\,h^{-1}$ and the factor of reliability is found to be 0.37 at 4380 h. If failure rate can be decreased, not only this system but also other wind turbine systems of real availability, capacity factor and exergy efficiency will be improved.

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Exergoeconomic analysis of an underground air tunnel system for greenhouse cooling system

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Ventilation
Greenhouse
Natural cooling
Heat exchanger
Energy
Exergy
Energy recovery

ABSTRACT

This paper investigates some exergoeconomic parameters for an underground air tunnel system based upon some operating conditions. The ratio of exergy loss rate to capital cost (R_{ex}) changes between 0.052 and 0.552. The total exergy losses values are obtained to be from 0.26 kW to 2.50 kW for the system. The daily average maximum cooling coefficient of performances (COP) values for the system are also obtained to be 11.96 for experimental period, while the total average COP is found to be 5.89. The overall exergy efficiency value for the system on a product/fuel basis is found to be 56.9%.

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Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

Monitoring of energy exergy efficiencies and exergoeconomic parameters of geothermal district heating systems (GDHSs)

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Keywords:
Energy
Exergy
Efficiency
Exergoeconomics
Monitoring
Renewables

ABSTRACT

In this work, the monitoring energy and exergy efficiency results of the last heating seasons of operation of the geothermal district heating systems (GDHSs) and their technical availability analysis and monitoring exergoeconomic parameters are presented. The case studies cover the actual system data taken from the systems in Afyon and Salihli GDHSs, Turkey. General energy, exergy, technical availability, and exergoeconomic analysis of the GDHSs are introduced. Furthermore, the average technical availability, real availability, capacity factor and energy and exergy efficiencies value of GDHSs have been analyzed.

Thermomechanical exergy and thermoeconomic analysis of geothermal district heating systems

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Abstract: The current paper presents the thermomechanical exergy and thermoeconomic analysis of geothermal district heating systems (GDHSs) in Turkey. The case studies cover the actual system data taken from the systems in Afyon, Gonen, and Salihli GDHSs, Turkey. General energy and exergy analysis of the GDHSs are introduced. Then the analysis applied to these GDHSs using actual thermodynamic data for their performance evaluations in terms of energy and exergy efficiencies are presented. Besides, thermoeconomic evaluations of GDHSs are given in tables.

Keywords: energy, efficiency, geothermal energy, renewable energy

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Renewable Energy

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Energetic performance analysis of a solar photovoltaic cell (PV) assisted closed loop earth-to-air heat exchanger for solar greenhouse cooling: An experimental study for low energy architecture in Aegean Region

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Energy
Heat exchanger
Low energy architecture
Renewable energy
Geothermal energy
Solar energy

ABSTRACT

An experimental system was developed and tested in order to investigate the energetic performance of a solar photovoltaic system (PV) assisted earth-to-air heat exchanger (underground air tunnel) that is used for greenhouse cooling at the Solar Energy Institute, Ege University, Izmir, Turkey. Average value of temperature differences between inlet and outlet of earth-to-air heat exchanger (EAHE) was observed 8.29 °C at experimental measurements. The average heat discharge rate (cooling load) was realized as 5.02 kW by using 0.7 kW fan. System was operated about 11 h/day. As a result, total electricity energy consumption of the system was measured to be 8.10 kWh and 34.55% of this energy demand was provided from photovoltaic cells. Furthermore, 65.45% of the electricity energy demand was provided from grid connection. Results are discussed and interpreted in the paper for various performance metrics.

C.B.Ü MAK. MÜH. TERMODİNAMİK FORMÜLLERİ (Hazırlayan : Doç.Dr.Leyla ÖZGENER)

$T(\mathrm{K}) = T(^\circ\mathrm{C}) + 273.15$ $\quad \Delta P = P_2 - P_1 = \rho g \Delta z$ $\quad P_{atm} = \rho g h$ $\quad \dfrac{dP}{dz} = -\rho g$

$T(\mathrm{R}) = T(^\circ\mathrm{F}) + 459.67$

$P_{gösterge} = P_{mutlak} - P_{atm}$ $\quad P_{vakum} = P_{atm} - P_{mutlak}$

$\Delta T(\mathrm{K}) = \Delta T(^\circ\mathrm{C})$

$x = m_{buhar} / m_{toplam}$ $\quad m = \dfrac{V}{v}$ $\quad y = y_f + x y_{fg}$ $\quad y \cong y_{f@T}$

Mükemmel gaz hal denklemi: $Pv = RT$ $\quad PV = mRT$

Sıkıştırılabilme Çarpanı:

$$Z = \frac{Pv}{RT} \quad Z = \frac{v_{actual}}{v_{ideal}} \quad T_R = \frac{T}{T_{cr}} \quad P_R = \frac{P}{P_{cr}} \quad v_R = \frac{v_{actual}}{RT_{cr}/P_{cr}}$$

Van der walls denklemi:

$$\left(P + \frac{a}{v^2}\right)(v - b) = RT \quad a = \frac{27R^2T_{cr}^2}{64P_{cr}}$$

$$b = \frac{RT_{cr}}{8P_{cr}}$$

Beattie-Bridgeman:

$$P = \frac{R_uT}{\bar{v}^2}\left(1 - \frac{c}{\bar{v}T^3}\right)(\bar{v} + B) - \frac{A}{\bar{v}^2}$$

$$A = A_0\left(1 - \frac{a}{\bar{v}}\right) \quad B = B_0\left(1 - \frac{b}{\bar{v}}\right)$$

Benedict-Webb-Rubin:

$$P = \frac{R_uT}{\bar{v}} + \left(B_0R_uT - A_0 - \frac{C_0}{T^2}\right)\frac{1}{\bar{v}^2} + \frac{bR_uT - a}{\bar{v}^3} + \frac{a\alpha}{\bar{v}^6} + \frac{c}{\bar{v}^3T^2}\left(1 + \frac{\gamma}{\bar{v}^2}\right)e^{-\gamma/\bar{v}^2}$$

İletimle Isı Transferi: $\dot{Q}_{iletim} = -k_t A \dfrac{dT}{dx}$

Taşınımla Isı Transferi: $\dot{Q}_t = hA(T_s - T_f)$

Işınımla Isı Transferi: $\dot{Q}_{ışınım} = \varepsilon\sigma A(T_s^4 - T_{çevre}^4)$

Elektrik işi: $W_e = V I \Delta t$ $\quad$ **Sınır işi:** $W_s = \int_1^2 P dv$ $\quad$ **Yerçekimi işi:** $W_g = m g (z_2 - z_1)$

İvme işi: $W_i = \dfrac{1}{2} m\left(V_2^2 - V_1^2\right)$ $\quad$ **Mil işi :** $W_{mil} = 2\pi n \tau$ $\quad$ **Yay işi :** $W_{yay} = \dfrac{1}{2} k\left(x_2^2 - x_1^2\right)$

İzobarik sistem için sınır işi: $W_s = P_0(V_2 - V_1)$ $\quad (P_1 = P_2 = P_0 = sabit)$

Politropik sistem için sınır işi: $W_s = \dfrac{P_2 V_2 - P_1 V_1}{1 - n}$ $\quad n \neq 1$ $\quad \left(P V^n = sabit\right)$

İdeal bir gaz için izotermal sistem için sınr işi : $W_s = P_1 V_1 \ln \dfrac{V_2}{V_1} = mRT_0 \ln \dfrac{V_2}{V_1}$ $\quad \left(P V = mRT_0 = sabit\right)$

Kapalı Sistemlerde Termodinamiğin I. Yasası: $Q - W = \Delta U + \Delta KE + \Delta PE$

$$W = W_{diger} - W_s \quad \Delta U = m(u_2 - u_1) \quad \Delta KE = \frac{1}{2} m(V_2^2 - V_1^2) \quad \Delta PE = mg(z_2 - z_1)$$

Sabit basınçta bir hal değişimi : $W_s + \Delta U = \Delta H$ $\quad Q - W_{diger} = \Delta H + \Delta KE + \Delta PE$

Özgül ısılar: $c_v = \left(\dfrac{\partial u}{\partial T}\right)_v$ $\quad c_p = \left(\dfrac{\partial h}{\partial T}\right)_p$ $\quad c_p = c_v + R$ $\quad k = \dfrac{c_p}{c_v}$

İdeal gazlar için:

$$\Delta u = u_2 - u_1 = \int_1^2 c_v(T)dT \cong c_{v,ort}(T_2 - T_1) \quad \Delta h = h_2 - h_1 = \int_1^2 c_p(T)dT \cong c_{p,ort}(T_2 - T_1)$$

Sıkıştırılamayan maddeler için: $c_p = c_v = c$

$$\Delta u = \int_1^2 c(T)dT \cong c_{ort}(T_2 - T_1) \quad \Delta h = \Delta u + v\Delta P$$

Kütlesel Debi : $\dot{m}=\rho VA$ **Hacimsel Debi :** $\dot{V}=VA=\frac{\dot{m}}{\rho}$

ρ=Yoğunluk

V=Ortalama akışkan hızı

A=Kesit alanı

Akış İşi : $\theta = h+ke+pe = h+V^2/2+gz$

Sürekli Akışlı Açık Sistem : $\sum \dot{m}_g = \sum \dot{m}_ç$ $q=\frac{\dot{Q}}{\dot{m}}$ $w=\frac{\dot{W}}{\dot{m}}$

$$\dot{Q}-\dot{W}=\sum \dot{m}_ç\left(h_ç+\frac{V_ç^2}{2}+gz_ç\right)-\sum \dot{m}_g\left(h_g+\frac{V_g^2}{2}+gz_g\right)$$

$$\dot{m}_1=\dot{m}_2 \Rightarrow \frac{1}{v_1}V_1A_1=\frac{1}{v_2}V_2A_2 \qquad \dot{Q}-\dot{W}=\dot{m}\left[h_2-h_1+\frac{V_2^2-V_1^2}{2}+g(z_2-z_1)\right]$$

$q-w=\Delta h+\Delta ke+\Delta pe$

Zamanla Değişen Açık Sistem : $\sum m_g - \sum m_ç = (m_2-m_1)_{KH}$

$$Q-W=\sum \int_{m_ç}\left(h_ç+\frac{V_ç^2}{2}+gz_ç\right)\delta m_ç-\sum \int_{m_g}\left(h_g+\frac{V_g^2}{2}+gz_g\right)\delta m_g+\Delta E_{KH}$$

Düzgün Akışlı Dengeli Açık Sistem :

$$Q-W=\sum m_ç\left(h_ç+\frac{V_ç^2}{2}+gz_ç\right)-\sum m_g\left(h_g+\frac{V_g^2}{2}+gz_g\right)+(m_2e_2-m_1e_1)_{KH}$$

Kontrol Hacmine Giren ve Çıkan Akışların Kinetik Enerji Değişimleri İhmal Edilirse :

$$Q-W=\sum m_ç h_ç-\sum m_g h_g+(m_2u_2-m_1u_1)_{KH}$$

Bir Isı Makinasının Isıl Verimi : : $\eta_{th}=1-(Q_L/Q_H)$ $\eta_{th,tersinir}=1-(T_L/T_H)$

$$COP_{SM}=\frac{1}{(Q_H/Q_L)-1}=\frac{Q_L}{W_{net,giren}} \qquad COP_{IP}=\frac{1}{1-(Q_L/Q_H)}=\frac{Q_H}{W_{net,giren}}$$

$$COP_{SM,tersinir}=\frac{1}{(T_H/T_L)-1} \qquad COP_{IP,tersinir}=\frac{1}{1-(T_L/T_H)}$$

$$\left(\frac{Q_H}{Q_L}\right)_{tr}=\frac{T_H}{T_L}$$

Clausius eşitsizliği : $\oint \frac{\delta Q}{T} \leq 0$ $\quad dS = \left(\frac{\delta Q}{T}\right)_{içten,tersinir}$ $\quad \Delta S = S_2 - S_1 = \int_1^2 \left(\frac{\Delta Q}{T}\right)_{içten,tersinir}$ $\quad \Delta S = \frac{Q}{T_0}$

Entropinin Artışı İlkesi : $dS \geq \frac{\delta Q}{T}$ $\quad \Delta S_{yalıtılmış} \geq 0$ $\quad S_{üretim} = \Delta S_{toplam} = \Delta S_{sistem} + \Delta S_{çevre} \geq 0$

Kapalı Sistem İçin:

$S_{üretim} = \Delta S_{toplam} = \Delta S_{sistem} + \Delta S_{çevre} \geq 0$ $\quad \Delta S_{sistem} = m(s_2 - s_1)$ $\quad \Delta S_{çevre} = \sum \frac{Q_R}{T_R}$

1.Genel İfade : $\dot{S}_{üretim} = \sum \dot{m}_ç s_ç - \sum \dot{m}_g s_g + \frac{dS_{KH}}{dt} + \sum \frac{\dot{Q}_R}{T_R}$

2.Düzgün Akışlı Dengeli Açık Sistem:

$S_{üretim} = (m_2 s_2 - m_1 s_1)_{KH} + \sum m_ç s_ç - \sum m_g s_g + \sum \frac{Q_R}{T_R} \geq 0$

3.Sürekli Akışlı Açık Sistem : $\dot{S}_{üretim} = \sum \dot{m}_ç s_ç - \sum \dot{m}_g s_g + \sum \frac{\dot{Q}_R}{T_R} \geq 0$

- **Bir Hal Değişimi İçin Entropi Değişimi Bağıntıları ve İzantropik Bağıntılar**

1.Saf Maddeler :

Herhangi Bir Hal Değişimi : $\Delta s = s_2 - s_1$ **İzantropik Hal Değişimi :** $s_2 = s_1$

2.Sıkıştırılamaz Maddeler :

Herhangi Bir Hal Değişimi : $s_2 - s_1 = c_{ort} \ln \frac{T_2}{T_1}$ **İzantropik Hal Değişimi :** $T_2 = T_1$

3. Mükemmel Gazlar :
a) Sabit Özgül Isılar (Yaklaşık Çözüm) :

Herhangi Bir Hal Değişimi: $s_2 - s_1 = c_{v,ort} \ln \frac{T_2}{T_1} + R \ln \frac{v_2}{v_1}$ $\quad s_2 - s_1 = c_{p,ort} \ln \frac{T_2}{T_1} + R \ln \frac{P_2}{P_1}$

İzantropik Hal Değişimi:

$$\left(\frac{T_2}{T_1}\right)_{s=sbt} = \left(\frac{v_1}{v_2}\right)^{k-1} \quad \left(\frac{P_2}{P_1}\right)_{s=sbt} = \left(\frac{v_1}{v_2}\right)^{k} \quad \left(\frac{T_2}{T_1}\right)_{s=sbt} = \left(\frac{P_2}{P_1}\right)^{(k-1)/k}$$

b)Değişken Özgül Isılar (Tam Çözüm) :

Herhangi Bir Hal Değişimi: $s_2 - s_1 = s_2^o - s_1^o - R \ln \frac{P_2}{P_1}$

İzantropik Hal Değişimi : $s_2^o = s_1^o + R \ln \frac{P_2}{P_1}$

- **Tersinir Hal Değişimi İçin sürekli akış işi :** $w_{tr} = -\int_1^2 v dP - \Delta ke - \Delta pe$

  Sıkıştırılamaz Maddeler İçin (v=sbt) : $w_{tr} = v(P_2 - P_1) - \Delta ke - \Delta pe$
- **Mükemmel Gazlarda Sıkıştırma İşlemi :**

  İzantropik Durum : $w_{komp,g} = \frac{kR(T_1 - T_2)}{k-1} = \frac{kRT_1}{k-1}\left[1 - \left(\frac{P_2}{P_1}\right)^{(k-1)/k}\right]$

  Politropik Durum : $w_{komp,g} = \frac{nR(T_1 - T_2)}{n-1} = \frac{nRT_1}{n-1}\left[1 - \left(\frac{P_2}{P_1}\right)^{(n-1)/n}\right]$

  İzotermal: $w_{komp,g} = RT \ln \frac{P_1}{P_2}$
- **Türbin,Kompresör ve Lüle İçin Adyabatik Bağıntılar**

$$\eta_T = \frac{\text{gerçek türbin işi}}{\text{izantropik türbin işi}} = \frac{w}{w_s} \cong \frac{h_1 - h_2}{h_1 - h_{2s}} \quad (\Delta ke = \Delta pe = 0 \text{ olursa})$$

$$\eta_K = \frac{\text{izantropik kompresör işi}}{\text{gerçek kompresör işi}} = \frac{w_s}{w} \cong \frac{h_{2s} - h_1}{h_2 - h_1} \quad (\Delta ke = \Delta pe = 0 \text{ olursa})$$