Exergy Analysis Of Combined Cycle Cogeneration Systems A

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Exergy Analysis Of Combined Cycle Cogeneration Systems A ***2021-12-19***

HOLDEN AYERS

Practical Approach to Exergy and Thermoeconomic Analyses of Industrial Processes Cambridge University Press Power plant performance can be assessed by the method of thermodynamic analysis. The goal of this thesis is to perform a thermodynamic analysis on the University of Massachusetts' Combined Heat and Power (CHP) District Heating System. Energy and exergy analyses are performed based on the first and second laws of thermodynamics for power generation systems that include a 10-MW Solar combustion gas turbine, a 4-MW low pressure steam turbine, a 2-MW high pressure steam turbine, a 100,000 pph heat recovery steam generator (HRSG), three 125,000 pph package boilers, and auxiliary equipment. The University of Massachusetts' CHP plant delivers all of the campus' steam and nearly all its electricity to the more than 200 buildings and nearly 10 million gross square feet of building space. Two 20-inch main steam transmission lines connect the plant to the campus. On an annual basis the plant generates approximately 1,100,000,000 pounds of steam and 100,000,000 kWh of electric power. The plant has a SCADA (Supervisory Control and Data Acquisition) system. Rockwell Automation's RSLinx OPC (Object Linking and Embedding for Process Control) server acquires data from up to 675 field instruments in the plant which is used for carrying out the analyses. The latest pollution control technologies, including advanced combustion turbine low NOx burners, advanced Selective Catalytic Reduction and Oxidation Catalyst

pollution control technologies are employed in the plant. System efficiencies are calculated for a wide range of component operating loads. Factors affecting efficiency of the CHP district heating system are analyzed. In the analysis, actual system data is used to assess the district heating system performance, energy and exergy efficiencies and exergy losses. Energy and exergy calculations are conducted for the whole year on an hourly basis. Factors affecting efficiency of the CHP district heating system are analyzed and recommendations made to improve the operating efficiency. The results show how thermodynamic analysis can be used to identify the magnitudes and location of energy losses in order to improve the existing system, processes or components.

Exergy, Energy System Analysis and Optimization - Volume I Pennwell Corporation

A comprehensive assessment of the methodologies of thermodynamic optimization, exergy analysis and thermoeconomics, and their application to the design of efficient and environmentally sound energy systems. The chapters are organized in a sequence that begins with pure thermodynamics and progresses towards the blending of thermodynamics with other disciplines, such as heat transfer and cost accounting. Three methods of analysis stand out: entropy generation minimization, exergy (or availability) analysis, and thermoeconomics. The book reviews current directions in a field that is both extremely important and intellectually alive. Additionally, new directions for research on thermodynamics and optimization are revealed.

The Exergy Analysis On A Natural Gas Based Combined Cycle Power PlantPerformance Analysis on Combined Cycle Power Plant

Discover a straightforward and holistic look at energy conversion and conservation processes using the exergy concept with this thorough text. Explains the fundamental energy conversion processes in numerous diverse systems, ranging from jet engines and nuclear reactors to human bodies. Provides examples for applications to practical energy conversion processes and systems that use our naturally occurring energy resources, such as fossil fuels, solar energy, wind, geothermal, and nuclear fuels. With more than one-hundred diverse cases and solved examples, readers will be able to perform optimizations for a cleaner environment, a sustainable energy future, and affordable energy generation. An essential tool for practicing scientists and engineers who work or do research in the area of energy and exergy, as well as graduate students and faculty in chemical engineering, mechanical engineering and physics.

Thermodynamic Optimization of Complex Energy Systems Elsevier

This book is a unique, multidisciplinary effort to apply rigorous thermodynamics fundamentals, a disciplined scholarly approach, to problems of sustainability, energy, and resource uses. Applying thermodynamic thinking to problems of sustainable behavior is a significant advantage in bringing order to ill-defined questions with a great variety of proposed solutions, some of which are more destructive than the original problem. The articles are pitched at a level accessible to advanced undergraduates and graduate students in courses on sustainability, sustainable

engineering, industrial ecology, sustainable manufacturing, and green engineering. The timeliness of the topic, and the urgent need for solutions make this book attractive to general readers and specialist researchers as well. Top international figures from many disciplines, including engineers, ecologists, economists, physicists, chemists, policy experts and industrial ecologists among others make up the impressive list of contributors.

Proceedings of the International Conference on Power Engineering 2007 LAP Lambert Academic Publishing

This title provides a reference on technical and economic factors of combined-cycle applications within the utility and cogeneration markets. Kehlhofer - and hos co-authors give the reader tips on system layout, details on controls and automation, and operating instructions.

Combined Power Plants Cambridge University Press

In this thesis, several configurations of combined cycle cogeneration systems proposed by the author and an existing system, the Bilkent Combined Cycle Cogeneration Plant, are investigated by energy, exergy and thermoeconomic analyses. In each of these configurations, varying steam demand is considered rather than fixed steam demand. Basic thermodynamic properties of the systems are determined by energy analysis utilizing main operation conditions. Exergy destructions within the system and exergy losses to environment are investigated to determine thermodynamic inefficiencies in the system and to assist in guiding future improvements in the plant. Among the different approaches for thermoeconomic analysis in literature, SPECO method is applied. Since the systems have more than one product (process steam and electrical power), systems are divided into several subsystems and cost balances are applied together with the auxiliary equations. Hence, cost of each product is calculated. Comparison of the configurations in terms of performance assessment parameters and costs per unit of exergy are also given in this thesis.

Including Combined Cycle Gas Turbine (CCGT) Plants GRIN Verlag

This volume provides detailed analysis of the basic thermodynamics and economic implications of combined power plants. It includes details of developments in Europe, the USA and Japan, and should be useful to practising engineers, policy-makers, and students in mechanical engineering.

Proceedings of the International Conference on Soft Computing for Problem Solving (SocProS 2011) December 20-22, 2011 LAP Lambert Academic Publishing

The objective is to provide the latest developments in the area of soft computing. These are the cutting edge technologies that have immense application in various fields. All the papers will undergo the peer review process to maintain the quality of work.

Performance indices of a power plant using exergy-based analyses Butterworth-Heinemann

This thesis deals with modelling and performance enhancements of a gas-turbine combined cycle power plant. A clean and safe energy is the greatest challenges to meet the requirements of green environment. These requirements given way the long time governing authority of steam turbine (ST) in the world power generation, and gas turbine

(GT) and its combined cycle (CCGT) will replace it. Therefore, it is necessary to predict the characteristics of the CCGT system and optimize its operating strategy by developing a simulation system. Several configurations of the GT and CCGT plants systems are proposed by thermal analysis. The integrated model and simulation code for exploiting the performance of gas turbine and CCGT power plant are developed utilizing MATLAB code. New strategies for GT and CCGT power plant's operational modelling and optimizations are suggested for power plant operation, to improve overall performance. The effect of various enhancing strategies on the performance of the CCGT power plant (two-shaft, intercooler, regenerative, reheat, and multi-pressure heat recovery steam generator (HRSG)) based on the real GT and CCGT power plants. An extensive thermodynamic analysis of the modifications of the most common configuration's enhancements has been carried out. The performance code for heavy-duty GT and CCGT power plants are validated with the real power plant of Baiji GT and MARAFIQ CCGT plants the results have been satisfactory. The simulating results show that the reheated GT has a higher power (388MW) while the higher thermal efficiency occurs in the regenerative GT (52%) with optimal pressure ratio and turbine inlet temperature. The performance enhancing strategies results show that the higher power output occurs in the intercooler-reheat GT strategy (404MW). Furthermore, the higher thermal efficiency (56.9%) and lower fuel consumption (0.13kg/kWh) occur in the intercooler-regenerative-reheat GT strategy. The analyses of the HRSG configurations show that the maximum power output (1238MW) occurred in the supplementary triple pressure with reheat CCGT while the overall efficiency was about 56.6%. The intercooler-reheat CCGT strategy has higher power output (1637MW) and the higher overall thermal efficiency (59.4%) and lower fuel consumption (0.047kg/kWh) occur with the regenerative-reheat CCGT strategy. The simulation result shows that the proposed GT system improved 19% of thermal efficiency and 22% of power output. In addition, the proposed CCGT system improved 4.6% of thermal efficiency for and 22.5% of power output. The optimization result shows that the optimum power (1280MW) and the overall thermal efficiency (65%) of the supplementary triple pressure with reheat CCGT. Therefore, the optimization procedure is reasonably accurate and efficient. Thus, the operation conditions and ambient temperature are strongly influenced on the overall performance of the GT and CCGT. The optimum efficiency and power are found at higher turbine inlet temperatures. It can be comprehended that the developed models are powerful tools for estimating the overall performance of the CCGT plants. The energy and exergy analysis models for the GT and CCGT plants are highly recommended for predicting them performance based on inlet air cooling system.

Solar Energy Engineering John Wiley & Sons

Exergetic Analysis

Advanced Thermodynamics for Engineers Cambridge University Press

This book comprises the select proceedings of the International Conference on Recent Trends in Developments of Thermofluids and Renewable Energy (TFRE 2020). The major topics covered include

aerodynamics, alternate energy, bio fuel, bio heat transfer, computational fluid dynamics, control mechanism for constant power generation, and energy storage. The book also discusses latest developments in the fields of electric vehicles, hybrid power systems, and solar and renewable energy. Given the scope of its contents, this book will be useful for students, researchers, and professionals interested in the field of thermofluids and renewable energy resources.

Thermodynamics Springer Science & Business Media

Technical Report from the year 2017 in the subject Physics - Other, , language: English, abstract: The objective of this applied industrial research was to conduct an exergy-based analysis for an Open Cycle Gas Turbine in Abu Dhabi in order to evaluate its performance under design conditions and during summer weather conditions. The first explanation for this investigation is that CO2 emissions from power generation plants in the United Arab Emirates are responsible for about 33% of the 200 million tons of the total CO2 emitted in 2013 in the country. The second reason for this industrial project is that the standard conditions used for the design of gas turbines are 288K, sea level atmospheric pressure and 60% relative humidity. However, the average summer weather conditions in Abu Dhabi are T=316K and a relative humidity of 50%. As a consequence, the effects of summer weather conditions on different performance indices of the power plant were also studied.

Geothermal Energy Systems CRC Press

This book deals with exergy and its applications to various energy systems and applications as a potential tool for design, analysis and optimization, and its role in minimizing and/or eliminating environmental impacts and providing sustainable development. In this regard, several key topics ranging from the basics of the thermodynamic concepts to advanced exergy analysis techniques in a wide range of applications are covered as outlined in the contents. Offers comprehensive coverage of exergy and its applications, along with the most up-to-date information in the area with recent developments Connects exergy with three essential areas in terms of energy, environment and sustainable development Provides a number of illustrative examples, practical applications, and case studies Written in an easy-to-follow style, starting from the basics to advanced systems

Challenges of Power Engineering and Environment Newnes

The world's ever growing demand for energy has resulted in increased consumption of fossil fuels for electricity generation. The emissions from this combustion have contributed to increasing ambient levels of carbon dioxide in the atmosphere. Many efforts have been made to curb and reduce carbon dioxide emissions in the most efficient manner. The computer process modeling software CHEMCAD was used to model a natural gas combined cycle powerplant for carbon capture and sequestration. Equipment for two proven carbon capture techniques, oxy-combustion and post-combustion amine scrubbing, were modeled. The necessary components modeled included an air separation unit, powerplant, amine scrubbing unit, and a carbon dioxide compression and drying unit. The oxygen concentration in the oxidizer supplied to the powerplant was varied from ambient air, 21%, to nearly pure oxygen, 99.6%. Exhaust gas

recirculation was incorporated to maintain a constant combustion temperature. At ambient conditions no air separation unit was necessary and all carbon capture was provided by the amine scrubbing unit. At concentrations ranging from 22 - 99% both oxy-combustion and amine scrubbing techniques are used at inversely varying degrees. At 99.6%, no amine scrubbing unit was necessary. As the oxygen concentration was varied operational parameters were investigated with the goal of identifying optimum operational conditions. Across the varying oxygen concentrations, the First Law efficiency losses ranged from 3.3 - 13.6%. The optimal operational point occurred when ambient air was supplied and exhaust gas recirculation was utilized for flame temperature control. A Second Law efficiency of 52.2% was maximized at an oxygen concentration of 22%. This corresponds to a 2.28% reduction in Second Law efficiency. An exergy analysis of each component identified the air separation unit as the component where the most improvements are possible. At 99% oxygen concentration, the Second Law efficiency of the air separation unit was 3%. Through modeling a natural gas combined cycle powerplant for carbon capture and varying the oxy-combustion characteristics, valuable information was gained in the understanding of operational losses associated with carbon capture.

Select Proceedings of TFRE 2020 EOLSS Publications

Combined Power Plants

Exergetic Analysis Springer Science & Business Media

This book is the proceedings of the International Conference on Power Engineering-2007. The fields of this book include power engineering and relevant environmental issues. The recent technological advances in power engineering and related areas are introduced. This book is valuable for researchers, engineers and students majoring in power engineering.

Nuclear Propulsion Techniques for Spacecraft Cambridge University Press

The two of the largest developments in the 20th century have been the invention of spacecraft, and the invention of nuclear power as a source of long lasting energy. Now, both technological fields have grown immensely to structure the technology of our world. These two fields are intertwined, as the future of space exploration depends on the availability of nuclear power. One of the most important requirements of a space flight mission is to be able to fly to furthest reaches of the universe. In fact, flying anywhere in our Solar System besides the moon will pose a considerable challenge as the distances that need to be travelled are great. The various means of chemical propulsion in spacecraft do not have the necessary high specific impulse and velocity to reach these long distances. But, with the availability of nuclear power, spacecrafts will have the thrust and the necessary power for exploration of interstellar distances. Nuclear propulsion poses the way for exploring our solar system and it provides the means for interstellar exploration. You can find contemporary techniques of nuclear space propulsion in this book and advanced futuristic nuclear space propulsion methods.

Gas Turbine Combined Cycle Power Plants CRC Press

Geothermal Energy Systems provides design and analysis methodologies by using exergy and enhanced exergy tools

(covering exergoenvironmental, exergoeconomic, exergetic life cycle assessment, etc.), environmental impact assessment models, and sustainability models and approaches. In addition to presenting newly developed advanced and integrated systems for multigenerational purposes, the book discusses newly developed environmental impact assessment and sustainability evaluation methods and methodologies. With case studies for integrated geothermal energy sources for multigenerational aims, engineers can design and develop new geothermal integrated systems for various applications and discover the main advantages of design choices, system analysis, assessment and development of advanced geothermal power systems. Explains the ability of geothermal energy power systems to decrease global warming Discusses sustainable development strategies for using geothermal energy sources Provides new design conditions for geothermal energy sources-based district energy systems

The Exergy Analysis On A Natural Gas Based Combined Cycle Power Plant Springer Nature

Thermodynamic Analysis and Optimization of Geothermal Power Plants guides researchers and engineers on the analysis and optimization of geothermal power plants through conventional and innovative methods. Coverage encompasses the fundamentals, thermodynamic analysis, and optimization of geothermal power plants. Advanced thermodynamic analysis tools such as exergy analysis, thermoeconomic analysis, and several thermodynamic optimization methods are covered in-depth for different configurations of geothermal power plants through case studies. Interdisciplinary research with relevant economic and environmental dimensions are addressed in many of the studies, along with optimization studies aimed at better efficiency, lower cost and lower environmental impact. Addresses the complexities of thermodynamic assessment in almost all operational plant configurations, including solar-geothermal and multi-generation power plants Includes an exemplary range of case studies, from basic to integrated Provides modern optimization methods, including entropy-based, exergoeconomic, artificial neural networks and multi-objective particle swarm Covers environmental impact considerations and integration with renewable energy systems

Heat Conversion Systems MDPI

Bridging the gap between concepts derived from Second Law of Thermodynamics and their application to Engineering practice, the property exergy and the exergy balance can be a tool for analyzing and improving the performance of energy conversion processes. With the exergy analysis it is possible to evaluate the performance of energy conversion processes not only on a thermodynamics basis but also by including production costs and environmental aspects and impacts of the studied processes. This comprehensive approach of the use of energy has, as one of the most important feature, the identification of sustainable ways of energy resources utilization. Based on the fundamentals of the exergy concept, its calculation, graphical representations and exergy balances evaluation, Exergy: Production Cost And Renewability describes the application of detailed exergy and thermoeconomic analysis to power plants and polygeneration systems,

petroleum production and refining plants (including hydrogen production), chemical plants, biofuel production routes, combined production of ethanol and electricity, aircraft systems design, environmental impact mitigation processes and human body behavior.

The presented case studies aim at providing students, researchers and engineers with guidelines to the utilization of the exergy and thermoeconomic analysis to model, simulate and optimize real processes and industrial plants.