ScienceDirect

Power Cycle

For several power cycles, the employment of multistage processes yields an improvement in energy production and decrease of destructions.

From: Integrated Energy Systems for Multigeneration, 2020

Related terms:

Energy Engineering, Solar Energy, Heat Exchanger, Power Generation, Concentrated Solar Power, Thermal Energy Storage, Supercritical, Gas Turbine, Organic Rankine Cycle, Rankine

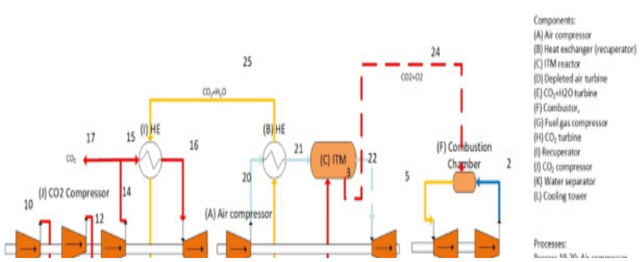
Oxyturbine power cycles and gas-CCS technologies

Hamidreza Gohari Darabkhani, ... Bahamin Bazooyar, in Carbon Capture Technologies for Gas-Turbine-Based Power Plants, 2023

3.10 The ZEITMOP cycle

The zero-emission ion transport membrane oxygen power (ZEITMOP) was introduced by Yantovski et al. (2004). The main working flow of the cycle is CO_2, which is enriched with O_2 in oxygen ion transport membranes (OITM), and CO_2/O_2 flow is an oxidant in a natural gas combustor (IEAGHG, 2015).

Fig. 3.13 shows the simplest version of the ZEITMOP cycle. It is gas-fired, but the cycle can be used also for pulverised coal and other fuel.



Read more

Read full chapter

URL: https://www.sciencedirect.com/science/article/pii/B9780128188682000060

Direct steam geothermal energy conversion systems

K. Phair, in Geothermal Power Generation, 2016

11.2.1 Overview

The power cycle for generating electricity from steam-dominated resources is comparatively simple, consisting of a turbine-generator, condenser, and waste heat rejection system. In principle, these elements are similar to the components used in traditional thermal power plants. However, the simplicity of the power cycle and the unique nature of the geothermal fluids have led to refinements in the power cycle to improve both overall plant efficiency and economic performance with high reliability and availability.

Both direct contact and surface condensers are used in geothermal power plants operating on vapor-dominated resources. Typical power cycles with direct contact and surface condensers are shown in Figs. 11.1 and 11.2. From a thermodynamic perspective, the direct contact condenser offers slightly better performance than a surface condenser. However, operational costs in the form of auxiliary power requirements for the hotwell pumps and increased chemical costs for emissions control, when

Read more

Read full chapter

URL: https://www.sciencedirect.com/science/article/pii/B9780081003374000115

26th European Symposium on Computer Aided Process Engineering

Jérôme Frutiger, ... *, in Computer Aided Chemical Engineering, 2016

1 Introduction

Power cycles, like Organic Rankine Cycle (ORC), allow converting industrial waste heat into usable electrical energy. In order to optimize the heat transfer process and the power generation, the influence of the working fluid is crucial. Multi-criteria database search and Computer

Aided Molecular Design (CAMD) can be applied to generate, test and evaluate promising pure component/mixture candidate as process fluids to help optimize cycle design and performance (Linke et al., 2015).

The first step in the molecular design problem formulation is commonly the identification of target properties. In many molecular design applications the expert knowledge or literature studies is used as a source for target property identification (Gani, 2004). We propose a new approach for the systematic analysis of target properties of molecular design problems with respect to the model output: the usage of sensitivity analysis as a global tool to address major target property identification.

In this study, we compare two methods for global sensitivity analysis, to identify and rank relevant target properties of working fluids: 1) Morris Screening techniques 2) Monte Carlo based standard regression (SRC) (Sin et al., 2009). The methodologies are highlighted in a case study involving an ORC design for energy recovery from low-heat waste streams. The two models are both well-known as an efficient way of performing global sensitivity analysis. The advantage of Morris's method is that it does not rely on restricted assumptions (e.g. linearizable model), but it does not include parameter correlation. On the other hand, SRC takes into account parameter interdependency and is based on well-established regression principles, but it is necessary to test, if the model fulfils the criterion of being linearizable. The goal of this study is to compare the performance of these methods in the context of a molecular design problem.

Read full chapter

URL: https://www.sciencedirect.com/science/article/pii/B9780444634283500527

Introduction and background

G. Musgrove, S. Wright, in
Fundamentals and Applications of Supercritical Carbon Dioxide (sCO_2) Based Power Cycles
, 2017

1.1 Introduction

A power cycle is a collection of processes and machinery used to generate useful energy from heat or momentum sources. For example, wind is considered a momentum source and fuel is considered a heat source. In keeping with the purpose of this book, power cycles using a momentum source are neglected and power cycles using a heat source are the main focus. While there are a number of different power cycles, the most commonly used for large-scale power generation are the Brayton cycle and the Rankine cycle (Fig. 1.1). A simple observation reveals that the Brayton cycle lies completely within the single-phase gas region, while the Rankine cycle spans the vapor and liquid phases separately. In either cycle, heat is added or removed at constant pressure, a pump or compressor increases the pressure before heat addition, and an expander (turbine) reduces the pressure and extracts work from the cycle. The simple cycle configurations shown in Fig 1.1 can be modified to increase

Read more

Read full chapter

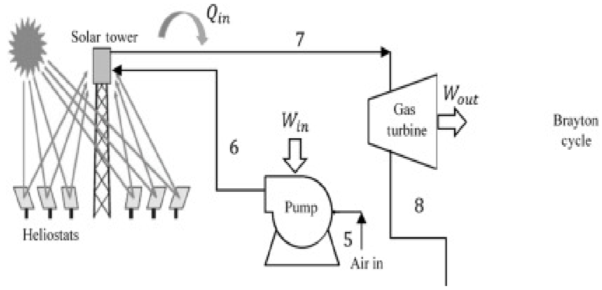
URL: https://www.sciencedirect.com/science/article/pii/B9780081008041000013

Thermodynamics for renewable energy systems

Muhammad Kamran, in Renewable Energy Conversion Systems, 2021

2.9.3 Solar combined power cycle

Solar combined power cycles are gaining popularity over the conventional combined cycle power plants. These are replacing the gas-based combustion with the solar thermal and the reduction in potential emissions. In the solar combined power cycle, the combustion chamber is replaced by a concentrated solar power system consisting of heliostats and the solar tower. Heliostats reflect the solar radiation to the solar receiver on the solar tower. In the upper Brayton cycle, the compressed air is passed through the solar tower that converts the air into hot gases. These hot gases are expanded over the gas turbine and the flue gases are passed through the heat exchanger where the heat is used to generate steam in the bottom Rankine cycle [8]. Fig. 2.15 shows the solar thermal combined power cycle.



[Read full chapter]

URL: https://www.sciencedirect.com/science/article/pii/B978012823538600004X

A new generation of solid particle and other high-performance receiver designs for concentrating solar thermal (CST) central tower systems

C.K. Ho, in

Advances in Concentrating Solar Thermal Research and Technology

, 2017

6.1.1 Background

Higher efficiency power cycles are being pursued to reduce the levelized cost of energy from concentrating solar power-tower technologies [1]. These cycles, which include combined air-Brayton, supercritical-CO_2 (sCO_2) Brayton, and ultra-supercritical steam cycles, require higher temperatures than those previously achieved using central receivers. Current central receiver technologies employ either water/steam or molten nitrate salt as the heat transfer and/or working fluid in subcritical Rankine power cycles. The gross thermal-to-electric efficiency of these cycles in currently operating power-tower plants is typically between 30% and 40% at turbine inlet temperatures<600°C. At higher input temperatures, the thermal-to-electric efficiency of the power cycles increases following Carnot's theorem. However, at temperatures greater than 600°C, molten nitrate salt becomes chemically unstable, producing oxide ions that are highly corrosive [2], which results in significant mass

[Read full chapter]

URL: https://www.sciencedirect.com/science/article/pii/B978008100516300006X

Alternative power cycles for selected Generation-IV reactors☆

Igor L. Pioro, ... Roman Popov, in
Handbook of Generation IV Nuclear Reactors (Second Edition), 2023

Abstract

This chapter examines power-cycle alternatives for a selection of Generation-IV nuclear reactors. Basic power-cycle options are discussed for different reactor technologies, with the three best-known and proven cycles described, along with their limitations for Gen-IV reactor use. The main conclusion presented, based on proven experiences in the thermal power industry, is that high-temperature Generation-IV nuclear-power reactors such as VHTRs and GFRs helium-cooled with maximum outlet temperatures up to 1000°C and 850°C, respectively, must be connected to combined power cycles. The chapter examines cycle alternatives for gas-cooled reactors (VHTRs and GFRs) and SFRs, and compares several cycles in terms of thermal efficiency. Numerous graphs and charts are provided of simplified reactor layouts with power-cycle comparisons.

Read full chapter

URL: https://www.sciencedirect.com/science/article/pii/B9780128205884000281

Geothermal Power Generation

Aniko Toth, Elemer Bobok, in
Flow and Heat Transfer in Geothermal Systems, 2017

11.2 The Clausius–Rankine Cycle

A power cycle consists of a series of repeating thermodynamic processes along a closed process path, while heat is converted into mechanical work. The most widespread working medium is water. The power cycle involves the water's change of phase from a liquid state into superheated steam. The expanding steam performs work on its surroundings, then it returns to its initial state, changing its phase into liquid. Such a cycle was invented by Clausius and Rankine, and is usually called the Clausius–Rankine cycle (in the English-speaking world, Rankine cycle only). A schematic diagram of the power plant in which the Clausius–Rankine cycle is realized is shown in Fig. 11.4.

Read more

Read full chapter

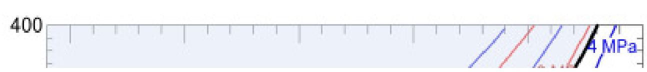
URL: https://www.sciencedirect.com/science/article/pii/B9780128002773000116

Physical properties

G. Musgrove, ... K. Brun, in
Fundamentals and Applications of Supercritical Carbon Dioxide (sCO_2) Based Power Cycles
, 2017

2.4 Overview of thermodynamic property trends

Supercritical power cycles operate close to the critical point to take advantage of the variations in thermodynamic properties as work is done on the fluid. A primary advantage of the cycle is that compression of the fluid is accomplished near the critical point where the isobars on a T–H diagram have a low slope (Fig.2.4). The low slope directly translates to a compression process where energy can be added to the fluid while incurring little increase in fluid temperature. This is analogous to subcritical gas compression where high compression efficiency can be achieved by intercooling the gas during the compression process to reduce the gas temperature. By reducing the amount of energy required to increase the sCO_2 pressure, the amount of work input to the cycle is significantly reduced compared to the work extracted from the cycle.



Read more

Read full chapter

URL: https://www.sciencedirect.com/science/article/pii/B9780081008041000025

Process modelling and performance analysis of the leading oxyturbine cycles

Hamidreza Gohari Darabkhani, ... Bahamin Bazooyar, in Carbon Capture Technologies for Gas-Turbine-Based Power Plants, 2023

4.2.1.4 Thermodynamic cycles

The thermodynamic concept of power cycles is based on the heat engine. The energy enters from the heat source at a high temperature, and part of it is converted to work, and the remaining energy exits into the heat sink at a low temperature. The power cycle's efficiency depends on the design parameters, including hot temperature source, the temperature of the heat sink, pressure ratio, the efficiency of compressor and turbine, heat exchanger and temperature of the power cycle. Different temperatures between the heat source and heat sink can affect the efficiency based on the Carnot concept.

There are two main types of thermodynamic power cycles: external combustion engines or internal combustion engines. Thermodynamic cycles are categorised in Table 4.1.

Read more

Read full chapter

URL: https://www.sciencedirect.com/science/article/pii/B9780128188682000059

ELSEVIER