Compressed air energy storage sealing layer

Renewable energy becomes more and more important to sustainable development in energy industry [1].Renewable energy has intermittent nature and thus requires large-scale energy storage as an energy buffer bank [2] pressed air energy storage (CAES) is one of large-scale energy storage technologies, which can provide a buffer bank between ...

Developing large-scale energy storage technology is crucial for mitigating the intermittency of renewable energy [6] pressed air energy storage (CAES) [7] and underground hydrogen storage (UHS) [8] are two promising energy storage technologies that serve as buffers between renewable energy production and consumption [9].The CAES ...

Mechanical responses induced by temperature and air pressure significantly affect the stability and durability of underground compressed air energy storage (CAES) in a lined rock cavern. An analytical solution for evaluating such responses is, thus, proposed in this paper. The lined cavern of interest consists of three layers, namely, a sealing layer, a concrete lining ...

Currently, there are two operating and well-documented Diabatic Compressed Air Energy Storage (D-CAES) facilities in the world: ... The maximum temperature variation reaches 16 K at point P1, a contact of the sealing layer with the compressed air. At point P5 (contact surface between concrete lining and rock mass) a temperature variation of 1.5 ...

Higher air temperatures within the cavern affect the stress response of the structure and can result in energy loss. Three-layer (sealing layer, concrete lining, surrounding rock) ... Compressed air energy storage is a mature technology suitable for large-scale energy storage, although the efficiency still needs to catch up to other energy ...

Combined with the field water sealing test, the tightness of the target salt cavern is verified. This method has been applied to the salt cavern screening and evaluation of a 300 MW compressed air energy storage power plant project in Yingcheng, Hubei Province, and remarkable results have been obtained, indicating the rationality of the method.

For compressed air energy storage (CAES) caverns, the artificially excavated tunnel is flexible in site selection but high in sealing cost. ... Air tightness of flexible sealing layer in compressed air storage energy caverns considering infiltration and accumulation of high-pressure air. J Storage Mater, 2024 (84) (2024), Article 110835. View ...

The air temperature fluctuations are reduced when steel sealing layer is employed. The thermal energy balance

through the sealing layer for 30 cy-cles, considering air mass flow rates of 0.22 kg s ...

Under the operating pressure of 4.5-10 MPa, the daily air leakage in the compressed air storage energy cavern of Yungang Mine with high polymer butyl rubber as the sealing material is 0.62% ...

Compressed Air Energy Storage (CAES) is a commercial, utility-scale technology that is suitable for providing long-duration energy storage. Underground air storage caverns are an important part of CAES. In this paper, an analytical solution for calculating air leakage and energy loss within underground caverns were proposed. Using the proposed ...

The cavern air leakage rate will be decreased to reduce the cavern operating pressure the injection air temperature, or the cavern radius and sealing layer thickness will be increased. Download PDF: Keywords: Compressed air storage energy, Polymer sealing layer, Air tightness, Permeability coefficient, Air density

Compressed air energy storage (CAES) is a large-scale energy storage technique that has become more popular in recent years. It entails the use of superfluous energy to drive compressors to compress air and store in underground storage and then pumping the compressed air out of underground storage to turbines for power generation when needed ...

Determining the airtightness of compressed air energy storage (CAES) tunnels is crucial for the selection and the design of the flexible sealing layer (FSL). However, the current airtightness calculations for flexible sealed CAES tunnels often ignore the process of high-pressure air penetration and accumulation in the lining and surrounding ...

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Compressed air energy storage (CAES) is a promising method for storing energy on a large scale. Although CAES has been studied over a few decades and two commercial CAES power plants have been operated since the 1990s (Glendenning 1976; Mehta and Spencer 1988; Crotogino et al. 2001), more recent studies have been devoted to the role of the CAES ...

The working principle of compressed air energy storage is: during the low load period of the grid, use renewable energy such as wind power and excess electricity in the grid to compress the air with the help of an air compressor, and seal the high-pressure air in a container (commonly known as an underground cavern); then during the peak load ...

The results obtained show significant heat flux between the pressurized air and the sealing layer and between the sealing layer and concrete lining. However, no temperature fluctuation was ...

air temperature fluctuations are reduced when steel sealing layer is employed. The thermal energy balance through the sealing layer for 30 cycles, considering air mass flow rates of 0.22 kg s 1 ...

Million cubic meters from abandoned mines worldwide could be used as subsurface reservoirs for large scale energy storage systems, such as adiabatic compressed air energy storage (A-CAES). In this paper, analytical and three-dimensional CFD numerical models have been conducted to analyze the thermodynamic performance of the A-CAES reservoirs in ...

Principle of the salt cavity gas sealing detection method. instruments, single detection results, and inaccurate evaluation results. Another is recommended by Geostock, which is widely used in ...

Large-scale compressed air energy storage (CAES) technology can effectively facilitate the integration of renewable energy sources into the power grid. The airtightness of ...

Compressed Air Energy Storage (CAES) technology is a promising solution for storing large amounts of energy. In CAES, surplus electric energy is converted into pressure potential energy by compressing air to a high-pressure state. ... Salt caverns exhibit low permeability and do not require an extra sealing layer. However, the salt rock strata ...

Air tightness of compressed air storage energy caverns with polymer sealing layer subjected to various air pressures Journal of Rock Mechanics and Geotechnical Engineering, 15 (2023), pp. 2105 - 2116, 10.1016/j.jrmge.2022.10.007

Full Length Article Air tightness of compressed air storage energy caverns with polymer sealing layer subjected to various air pressures Shikang Qina, Caichu Xiab,**, Shuwei Zhoua,* aCollege of Civil Engineering, Tongji University, Shanghai, 200092, China b Institute of Rock Mechanics, Ningbo University, Ningbo, 315211, China article info

Compressed air energy storage (CAES) is considered as a promising energy storage solution to balance the energy load leveling. The previous engineering practice usually locates the air storage caverns at deep locations from the surface of the earth. ... The results show that the sealing layer could stop the compressed air from leaking and ...

The core principle of compressed air energy storage [13] is to utilize surplus electricity generated from renewable energy sources to compress air into large-scale storage facilities bsequently, during periods of peak energy demand, the compressed air is released (or supplemented with natural gas for combustion) to drive turbines for electricity generation, ...

The storage space for the compressed air represents a critical component in this system. The challenge lies in identifying suitable locations that meet at least three essential technical and environmental criteria to ensure

safe operation and minimize energy loss [7]: (1) Substantial capacity: the chosen location should have a significant capacity for storing ...

Abstract Compressed air energy storage (CAES) is attracting attention as one of large-scale renewable energy storage systems. Its gas storage chamber is one of key components for its success. ... Prado et al. 18 analyzed the thermodynamic properties of a chamber with a seal layer and a 35 cm concrete lining when the working air pressure of ...

Compressed air energy storage (CAES) is a technology that uses compressed air to store surplus electricity generated from low power consumption time for use at peak times. ... °C in the numerical simulation due to mixing with injected air at 49 °C, in addition to the heat exchange between the sealing layer and the compressed air. In ...

DOI: 10.1016/j.jrmge.2022.10.007 Corpus ID: 253827008; Air tightness of compressed air storage energy caverns with polymer sealing layer subjected to various air pressures @article{Qin2022AirTO, title={Air tightness of compressed air storage energy caverns with polymer sealing layer subjected to various air pressures}, author={Shikang Qin and Caichu Xia ...

the air to the sealing layers was calculated. Finally, the energy balance through the sealing layer was obtained during air charging and discharging. 2. Materials and Methods 2.1. Problem Statement Underground space in abandoned mines may be used as compressed air storage systems for CAES plants. The simplified schematic diagram of the CAES ...

Compressed air energy storage (CAES) is one of the most promising large-scale energy storage technologies. Compared with pumped hydroelectric storage ... (FRP) sealing layer on the surface of the lining. A plug was set at the inlet end of the test chamber to bear the thrust of high-pressure compressed air (maximum design pressure was 10.0 MPa). ...

Underground multi-layer cavern is a key component in the compressed air energy storage (CAES) engineering and its optimal design is of vital importance for improving the CAES efficiency, while most of the optimization models for CAES cavern only have strength index without consideration of economical index. In this study, a finite element method of the CAES multi-layer cavern ...

Determining the airtightness of compressed air energy storage (CAES) tunnels is crucial for the selection and the design of the flexible sealing layer (FSL). However, the current airtightness calculations for flexible sealed CAES tunnels often ignore the process of high-pressure air penetration and accumulation in the lining and surrounding rock after passing ...

During the operation of compressed air storage energy system, the rapid change of air pressure in a cavern will cause drastic changes in air density and permeability coefficient of sealing layer. To calculate and properly

evaluate air tightness of polymer sealing caverns, the air-pressure-related air density and permeability must be considered. In this context, the high-pressure air ...

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