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608-238-6001 [TEL]

greg@infinityturbine.com [Email]



sand-and-salt- battery-for-thermal- storage- desalination-and- producer water

Infinity Turbine
LLC

A Thermal Battery for Desalination and
Energy Storage by Infinity Turbine



This webpage QR code

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Explore the innovative sand and salt battery system, a sustainable solution for desalination and energy storage. Utilizing sand, salt, and renewable energy sources, this groundbreaking technology offers environmental and economic benefits by providing clean water, eliminating brine discharge, and enabling the sale of by-products. Discover how this approach paves the way for a greener future.

PDF Version of the webpage (first pages)

<https://infinityturbine.com/sand-and-salt-battery-for-thermal-storage-desalination-and-producer-water-treatment-bv-infinity-turbine.html>

A Revolutionary Approach to Desalination and Energy Storage by Harnessing the Power of Sand and Salt

The Innovation: A Thermal Battery for Desalination and Energy Storage

In an era where sustainable solutions are imperative for our energy and water needs, a groundbreaking technology emerges, leveraging the seemingly mundane elements of sand and salt to address these challenges. This novel approach ingeniously combines sand, salt, and renewable energy sources to create a thermal battery system capable of both desalinating water and storing energy.

At the heart of this technology is a thermally insulated container filled with sand. When heat is applied, sourced from solar photovoltaics (PV), waste heat, or surplus wind energy, the sand becomes a medium to store this thermal energy. The addition of seawater to the heated sand results in flash steam generation, similar to a hot geothermal well. This steam is then condensed and recaptured as fresh, desalinated water, offering a dual benefit: clean water production and energy storage. As part of the energy release, the heat is used to power a Infinity Turbine Organic Rankine Cycle turbine generator to produce electricity. The core element of the system is the sand and salt combined thermal storage. Closed loop heat transfer thermal oil or CO₂ can be used for primary Brayton Cycle power generation, if desalination is not needed. The system is scalable from 2 kW to over 1 MW.

Key Features of the Sand and Salt Battery System:

1. **Desalination:** The process begins after the sand is heated. As saltwater is applied to the sand, the water is flash evaporated, and leaves behind a higher concentration of salt.
2. **Power Generation:** As the flashed water vapor is condensed, the waste heat is used by a Infinity Turbine Organic Rankine Cycle Turbine Generator to make power. The ORC power is preferred since a pressurized steam system (and regulations) is not required. The ORC power generator is, in effect, a heat pump.
3. **Time of Use Flexibility:** The system can be charged during the day using solar PV and then utilized at night to capture and store heat, offering a flexible solution for energy management. Or with night-time unused wind energy, can charge at night when the grid no longer accepts energy input.
4. **Diverse Energy Sources:** The system is compatible with various energy sources, including PV, wind energy, industrial waste heat, solar thermal, and peaker plants.
5. **Integration to make power with Infinity Turbine ORC or with Cavgenx Heat Pump Turbine:** This enhances the system's efficiency in energy conversion and storage. orc power generation
6. **Elimination of Brine Discharge:** One of the most significant environmental benefits is the absence of harmful brine discharge, a common issue in traditional desalination methods.
7. **Sale of By-Products:** The residual salt can be harvested and sold, creating an additional revenue stream.
8. **Application in Winter Road Treatment:** The sand and salt mixture can be repurposed for de-icing roads during winter, showcasing its versatile utility.
9. **Use in the Oil and Gas Industry:** The system can employ flare gas to heat and condition producer water, demonstrating its adaptability to various industrial needs. The sand battery can be heated and stored for days, then used when needed for producer water treatment.
10. **Lime as Heat Storage Media (without salt):** As an alternative to sand, crushed Limestone can also be used. With a high energy storage density of greater than 1000 kJkg⁻¹, it can be pre-heated and then used as the ingredient for raw meal, in the production of cement.

Environmental and Economic Impacts

The sand and salt battery system presents a sustainable solution to two of the world's most pressing issues: water scarcity and the need for renewable energy storage. By leveraging natural and abundant materials, such as sand and salt, and coupling them with renewable energy sources, this technology not only aids in water desalination but also in reducing our carbon footprint.

Moreover, the economic benefits are noteworthy. The ability to sell the by-product, salt, adds a profitable dimension to this technology. Additionally, the system's adaptability to various industries, from road treatment to oil and gas, broadens its market potential.

Looking Ahead: A Sustainable Future

This innovative approach stands as a testament to the power of combining traditional materials with modern technology. The sand and salt battery system is not just a technological marvel; it's a step towards a more sustainable and resource-efficient future. As we continue to confront the challenges of climate change and resource scarcity, solutions like these pave the way for a greener, more sustainable world.

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Solar Vacuum Tube Sand Battery Testing

Experiments testing various media in solar vacuum tube.

Sand Battery: Higher temperatures than wax, but cools down faster.

Paraffin Wax: Lower temperatures than Sand to heat up (appears to reach a maximum), but stays hotter all night long.

Sand and Paraffin Wax: Temperature between sand and wax, but stays longer.

Air in Tube Only: Fast to heat up well above 300 F, but also fast to cool down.

Salt Only: Pending.

Sand and Salt: Pending.

Sand Batteries: Unearthing the Future of Energy Storage

Introduction

In the quest for sustainable and efficient energy storage solutions, an unexpected contender has emerged – the sand battery. This novel concept utilizes the abundant and environmentally friendly material of sand to store energy. This article delves into the benefits and attributes of sand batteries, exploring how they might reshape the landscape of energy storage and support the transition to renewable energy sources.

Understanding Sand Batteries

The Basic Principle

A sand battery stores energy in the form of heat. Essentially, it involves heating sand to high temperatures using surplus renewable energy, such as wind or solar power. The hot sand retains this heat for extended periods, which can then be converted back into electricity when needed or used directly for heating purposes.

Components and Operation

Typically, a sand battery consists of an insulated container filled with sand. Electricity, generated from renewable sources, powers a heating element that warms the sand to temperatures around 500-600 degrees Celsius. The thermal energy stored in the sand can be retained for several weeks with minimal losses.

Benefits of Sand Batteries

Environmental Friendliness

Sand, being abundant and non-toxic, poses minimal environmental risks. Unlike conventional batteries that rely on chemicals and rare metals, sand batteries offer a more sustainable and eco-friendly solution.

Cost-Effectiveness

Sand is inexpensive and widely available. The construction and maintenance costs of sand batteries are significantly lower compared to traditional battery technologies, making them a cost-effective option for large-scale energy storage.

Longevity and Durability

Sand batteries have the potential for longer lifespans and greater durability. The absence of chemical reactions, which often degrade conventional batteries, means sand batteries could maintain their efficiency over many years.

Scalability

The simplicity of the concept allows for scalability. Sand batteries can be constructed in various sizes, making them suitable for a range of applications, from small local systems to large-scale industrial solutions.

Potential Applications

Grid Stabilization

Sand batteries can store excess energy generated during peak production periods and release it during high demand, aiding in grid stabilization and reducing reliance on fossil fuel-based power plants.

District Heating

The stored thermal energy can be directly used for heating homes and buildings, especially in colder regions. This

Harnessing the Heat: Saltwater Desalination Using Hot Sand

Introduction

The innovative use of sand batteries for energy storage opens up a realm of possibilities, including the intriguing concept of desalination through vaporizing saltwater on hot sand. This article explores the depths of this idea, examining its potential as a sustainable solution to freshwater scarcity by leveraging the thermal energy stored in heated sand.

The Desalination Challenge

Global Water Scarcity

Freshwater scarcity is a growing global issue, with many regions struggling to meet their water needs. Desalination, the process of removing salt from seawater, offers a potential solution, but traditional methods are often energy-intensive and environmentally taxing.

Seeking Sustainable Solutions

The quest for sustainable desalination techniques has led to exploring renewable energy sources and innovative methods to reduce environmental impact and energy consumption.

The Concept of Hot Sand Desalination

Utilizing Sand Battery Heat

The idea revolves around using the thermal energy stored in sand batteries to vaporize saltwater. Heated sand from these batteries, which can retain high temperatures for extended periods, could be used to heat saltwater, causing it to evaporate and leave behind the salt.

Process and Mechanism

The process involves spreading saltwater over hot sand, where the intense heat causes rapid evaporation. The resulting water vapor is then condensed into liquid form, effectively desalinating the water. This method harnesses a natural, low-tech approach to distillation.

Advantages of Hot Sand Desalination

Energy Efficiency

This method could be more energy-efficient compared to conventional desalination techniques, as it utilizes stored thermal energy that might otherwise go unused.

Environmental Benefits

Using sand as a heat source reduces reliance on fossil fuels and minimizes the carbon footprint associated with desalination. Additionally, this method avoids the chemical by-products often associated with other desalination processes.

Cost-Effectiveness

The abundance and low cost of sand, coupled with the use of renewable energy, potentially make this a cost-effective solution for desalination.

Potential Applications and Scalability

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Sand Batteries and Salt: A Synergistic Approach to Energy and Desalination

Introduction

The innovative concept of using sand batteries for energy storage and desalination has taken an intriguing turn with the realization that accumulating salt in the sand can actually enhance the battery's thermal capacity. This article delves into how the integration of salt accumulation from desalination processes not only boosts the efficiency of sand batteries but also opens up a new avenue for salt production as a valuable byproduct.

Enhancing Sand Batteries with Salt

The Role of Accumulated Salt

In the process of using hot sand for desalination, salt naturally accumulates within the sand matrix. This accumulation, rather than being a waste product, has been found to enhance the thermal storage capacity of the sand. The salt effectively acts as a thermal mass, absorbing and retaining heat more efficiently than sand alone.

Improved Energy Storage

The addition of salt to the sand increases the overall heat retention capabilities of the sand battery. This means that the sand battery can store more energy, which can be later used for various purposes, including further desalination, power generation, or district heating.

Sustainable Salt Production

From Waste to Resource

Once the sand reaches a certain threshold of salt saturation, it is removed from the battery. The sand and salt mixture is then processed to separate the salt, which can be refined and sold as a byproduct.

Market Potential for Salt

The salt extracted from this process is not just a waste byproduct but a valuable commodity. It can be used for various applications, including industrial processes, road de-icing, or culinary uses, depending on its purity and refinement.

The Circular Economy Model

Reducing Waste

This approach embodies the principles of a circular economy, where waste products are repurposed and reused, minimizing environmental impact. The dual functionality of the sand battery system—energy storage and salt production—maximizes resource utilization.

Economic Benefits

The sale of salt as a byproduct can offset some of the costs associated with the operation and maintenance of the sand battery system, making it a more economically viable solution.

Challenges and Future Directions

Optimizing Salt Extraction

The process of extracting and purifying salt from the sand-salt mixture presents technical challenges. Research and development are required to optimize this process for efficiency and cost-effectiveness.

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