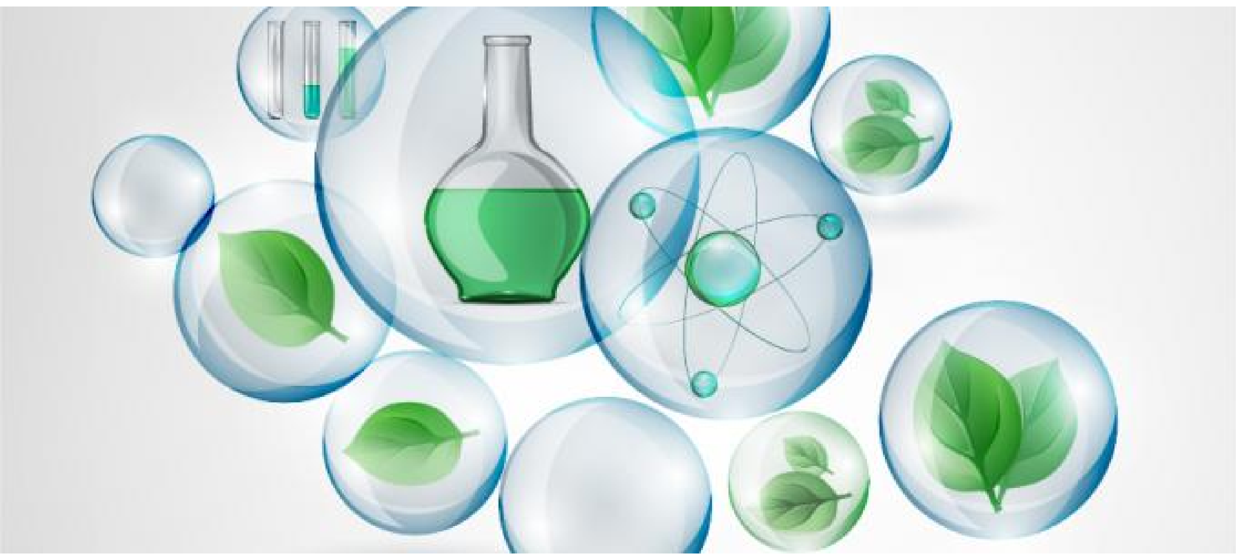
Ficha del catálogo dinámico de tecnologías para la bioeconomía

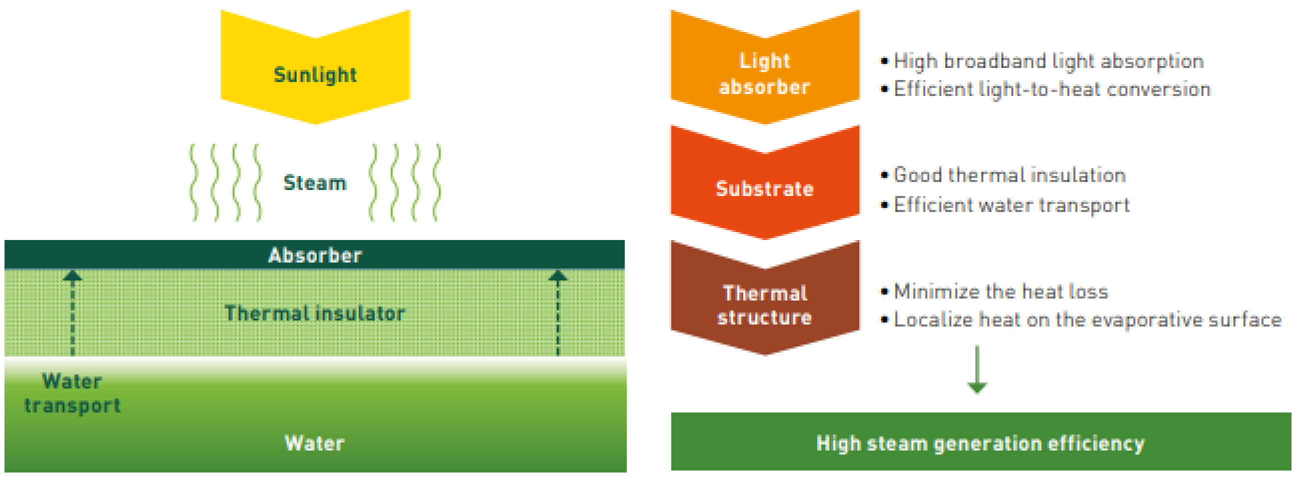
Solar vapor generator (SVG) to freshwater production using coconut husk



Brief description

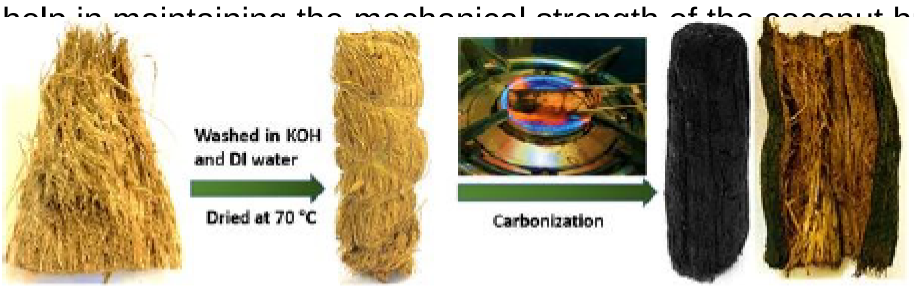
Freshwater scarcity is now a global concern due to the increase in water pollution and the human population so it must be found a cost-effective solution for freshwater generation using renewable energy sources. Solar-driven water purification technology is being considered an energy-efficient way of producing clean water. The principle of this technology is to convert solar energy into heat that generates steam, used to heat water that can be applied to heating systems or to generate clean water from seawater or polluted water.

The main focus is to prepare efficient solar vapor generators (SVG), why it was design a SVG by carbonizing the surfaces of a piece of coconut husk using a household liquefied petroleum gas stove. Carbonized coconut husk (CCH) based evaporators show a maximum evaporation rate of 3.6 kg m-2 h -1 under 1 sun illumination (AM 1.5) and offering a thermal efficiency of 144%.



Process detail

To prepare the CCH evaporators, raw coconut husk (RCH) was cut into pieces, washed thoroughly using KOH solution followed by DI water, compressed tightly into a cylindrical shape, and dried at 70°C in an oven. The density of coconut husk was approximately 0.33 g cm-3 after drying. Finally, its cylindrical surfaces and top surface were carbonized using a household LPG stove in an environmental condition. As it does not require any specific tool to fabricate, an ordinary person can easily design the same CCH evaporator for domestic use. only the surface has been carbonized, and the bulk remains the same, which will help in maintaining the mechanical strength of the coconut husk.



The porous structure of the CCH will enhance solar absorption by trapping the incident photons, increase the effective surface area of evaporation, and act as the escape path to the vapor from the evaporator. Motivated by these favourable characteristics, the CCH was employed to check its potential for solar steam generation in ambient conditions for 2D and 3D shapes. First, the CCH evaporator's height was optimized by measuring the evaporation rate with varying heights from 0.7cm (2D) to 7 cm under 1 sun illumination. CCH provides the best performance at the height of around 6 cm. To demonstrate the practical water purification, soapwater, detergent-water, and methylene blue (MB) solution were selected to simulate wastewater using a handmade prototype purification setup. The absorption spectrum was used to examine the concentration of the pollutants. The CCH evaporators efficiently reject contaminants after the purification, as confirmed by the zero-light absorption and the color changes. To further evaluate the desalination effect, artificial seawater was prepared by dissolving 3.5 wt% NaCl in water. The stability of seawater purification was done by continuously measuring the evaporation rate for 10 hours under 1 sun illumination. The qualities of the purified water from all these solutions were further tested by measuring the pH and conductivity. The pH and conductivity values of water after purification from different contaminated solutions was found comparable with that of RO and DI water, indicating that CCH evaporators can effectively decontaminate sewage.

Details

Country:
India

Actors:
Academia

Process type:
Carbonization

Chain:
Coconut

Raw material:
Coconut husk

Final product:
Solar steam generator

Experience period:
2021

Scale:
Pilot

Contact data
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Reference link
https://www.researchgate.net/publication/351474349_Environment_Pollutant_to_Eff…