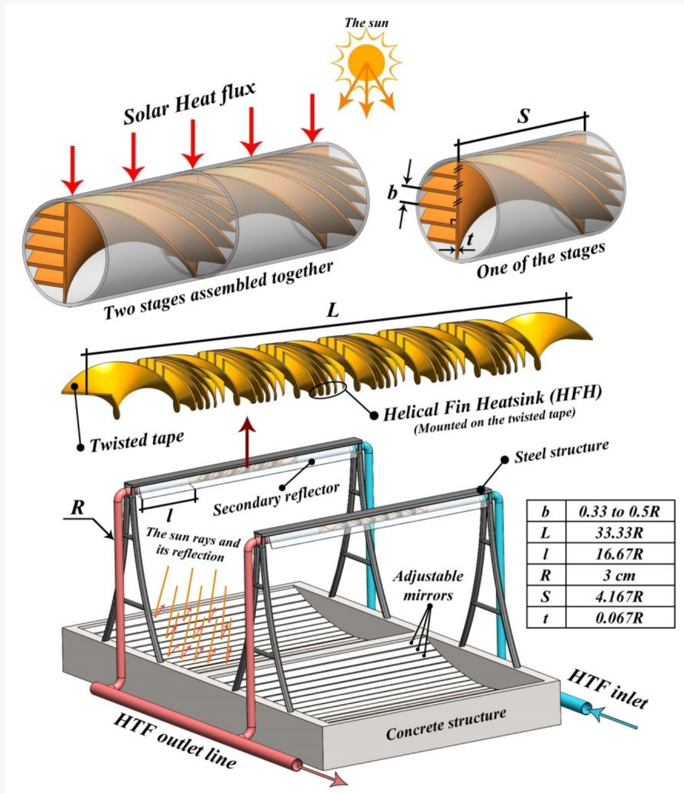
Nanofluids and turbulators can boost renewable energy and slash dependence on fossil fuels, say scientists

When combined, nanofluids and turbulators can help reduce reliance on fossil fuels and control of indoor temperature.



Hybrid nanofluid turbulent transportation through a tube with an innovative twisted tape combined with helical fins heat sink.

SHARJAH, EMIRATE OF SHARJAH, UNITED ARAB EMIRATES, January 6, 2025 /EINPresswire.com/ -- Nanofluids and turbulators have enormous potential to boost thermal conductivity, increase heat transfer efficiency, cut energy costs, and reduce reliance on fossil fuels, scientists say.

Nanofluids, also called nanoparticles, are fluids containing nanometer-sized particles, while turbulators, which are typically made of stainless steel, consist of small metal baffles or coiled wire.

Nanofluids and turbulators have recently emerged as new techniques to boost cooling systems, maximize heat transfer rates and enhance renewable energy.

The scientists' most outstanding finding reveals that substantial benefits in terms of energy transfer, cooling, and heating can be obtained when nanofluids and turbulators are combined to develop techniques that will maximize their functions.

Heating and cooling consume nearly half of the global energy and are responsible for more than 40% of carbon dioxide emissions related to energy. Conditions are expected to aggravate with the demand for air-conditioning slated to surge by 45% in 2050.

For the scientists, it is an urgent matter for the world "to turn to the broader utilization of renewable energies instead of fossil fuels to effectively tackle this widely recognized challenge of transition to sustainable energy."

They furnish their study "with the design of a roadmap that integrates advanced (nanofluid and turbulator-based) technologies into sustainable energy systems. The authors identify "huge potential in these technologies to make considerable contributions towards the global transition towards renewable energy sources."

The details and findings of the research are published in the journal Applied Thermal Engineering, and the scientists maintain that there is growing interest in their work and similar types of research from industries like automotive, aerospace, and renewable energy.

The research is the product of collaboration and partnership among five universities in different parts of the world. The authors originate from the University of Sharjah in the United Arab Emirates, U.K.'s Lancaster University, Saudi Arabia's King Fahd University of Petroleum and Minerals, Greece's National Technical University of Athens, and Malaysia's Sunway University.

The research attends to the need for sustainable energy solutions, helping point the way towards better performance of energy systems with reduced environmental impacts, according to lead author Dr. Zafar Said, an associate professor at University of Sharjah's College of Engineering.

"This can notably improve the efficiency of renewable energy technologies, besides contributing to a shift away from fossil fuel economies," Dr. Said goes on. "New materials, such as phase-change materials and hybrid nanofluids, were introduced, holding much promise for more efficient energy storage and transportation."

Dr. Said, whose research centers on nanofluids, heat transfer and sustainable energy, says he and his colleagues develop new technologies which, if utilized, would "enhance the heat transfer processes, which are crucial in energy applications, focusing on nanofluids, turbulators, and new working fluids to investigate their potential and efficiency improvement in solar collectors and heat exchangers.

"Our research emphasizes environmental sustainability, answering the modern goals for clean energy and low carbon emissions. It looks at how these advanced technologies would be incorporated into large-scale applications and points toward a roadmap for transition toward renewable energy systems."

In the meantime, the authors admit that the technique, as presented in their study, still "requires careful consideration of potential drawbacks, such as increased nanoparticle deposition, which may reduce system efficiency. This holistic approach considers economic, environmental, and social factors, ensuring compliance with global sustainability benchmarks and contributing to energy system sustainability research."

However, Dr. Said is upbeat as he endows turbulators and nanofluids with higher thermal conductivity and efficiency, as well as significant potential in cooling systems and renewable energy devices.

“Our research highlights the transformative potential of nanofluids and turbulators in shaping the future of energy systems. Integrating these advanced materials into everyday applications can bridge the gap between energy efficiency and environmental sustainability," he notes.

While the scientists demonstrate how the integration of nanofluids and turbulators can achieve maximum efficiency of cooling and heating devices in terms of environment, volume, and cost, they at the same time underscore certain challenges ahead, particularly in relation to stability and scalability. “These practical techniques thus illustrate that modern heat transfer systems can be feasible and usable in reality. Translating theory into practice becomes easier in this respect,” they write.

Dr. Said points out that the research’s findings “directly apply to efficient systems design in HVAC, transportation, and renewable energy industries, further showing the scalability and systems economics at larger sizes.”

HVAC, an acronym for Heating Ventilation and Air Conditioning, is a system operating various technologies that can comfortably and sustainably control humidity, temperature, and purity of the air in enclosed spaces.

The authors note, “The future energy systems are going to be designed based on the principles of efficiency and the usage of new materials. Some of the major challenges in research involve developing new materials and combinations to achieve cost reductions and enhancement of heat transfer using turbulators and special fluids.

“This paper has highlighted the importance of efficient energy consumption by combining different new methods with renewable and alternative energy sources. It is urgent to turn to the broader utilization of renewable energies instead of fossil fuels to effectively tackle this widely recognized challenge of transition to sustainable energy.”

The authors describe their research as “visionary” as it outlines “key hurdles to be conquered if such technologies significantly impact future sustainable energy systems.” They provide a guideline on how to address the remaining technological obstacles.

“These are inclusively outlined as novel material development, performance enhancement, long-term stability, life cycle methodology, and cost reduction in implementing innovative technologies into large-scale industrial applications.”

Other obstacles for future research to tackle, according to the authors, include attaining industrial-scale technologies, reducing costs further and reaching a sustainable level of scalability and material compatibility.

“The realization of the technology, cost, scalability, and material compatibility are key factors to consider. These technologies can also be applied to many disciplines, like those concerned with automotive and aerospace engineering, where the control of heat is very much an issue.”

Despite obstacles, the authors assert that the future holds bright prospects for nanofluids, turbulators, and new working fluids which are expected to become the keys to revolutionizing heat transfer. Advancements in these fields will have an impact on automotive and aerospace engineering, which would greatly benefit from improved thermal management.

“Moreover, applying heat transfer enhancement techniques can lead to a higher pressure drop in the flow, which increases the unit's operational cost, especially in the cases with turbulators. However, the proper design of the enhanced units can minimize the increase in the pumping work demand, and finally, the overall designs can effectively enhance the global system performance.”

They stress that additional research is necessary to bridge the chasm between theory and practice in the use cases involving nanofluids, turbulators, and new working fluids, and also to improve aeronautical and automotive cooling systems.

“Nanofluids can be used to enhance the heat transfer inside car cooling systems. This will provide improved performance and better fuel economy for automobiles. Specific case studies can be done on this,” the authors highlight in their study.

They also urge scientists to introduce machine learning in their research to optimize their technologies and devices using nanofluids and turbulators. This approach “leverages AI and machine learning to tune a system to the most optimal configuration for business. It greatly reduces experimentation and accelerates the dissemination of technologies.”

LEON BARKHO
University Of Sharjah
+971 501654376
email us here
