New Transparent Aerogel “Sponge” Spikes the Solar Power Ball

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It’s only a matter of time before concentrating solar power slips into the industrial process heat field, if a new aerogel pans out.

It’s modular, it’s easily deployed, and it can generate industrial process heat at up to 1,300 degrees Fahrenheit. That’s the pitch for a new concentrating solar power system equipped with heat-trapping tiles in the form of a transparent, sponge-like aerogel. The ultimate aim is to scrub fossil energy from hard-to-decarbonize areas of the industrial sector. Now, where are all those people who thought concentrating solar power was a dead end?

Concentrating Solar Power To Anyone: The Report Of My Death Was…

Concentrating solar power systems are designed to deliver heat, not electricity. They work by collecting ambient sunlight from many different points, typically from an array of specialized mirrors or a series of long troughs. The concentrated light is focused on a central point in the case of mirrors, or long tubes in the case of troughs. The heat is then transferred to a transportable, recirculating fluid such as molten salt or a specialized oil.

Typically, the hot fluid is then used to boil water for generating steam. In turn, the steam is used to run turbines to produce electricity. That raises the question of why not just use solar cells to generate electricity directly, and skip the whole thing about making steam. After all, the steam thing adds more infrastructure, more complexity, and more costs.

That was the basic argument deployed by critics of concentrating solar technology during the early years. However, one of the attractions of concentrating solar power is the energy storage angle. Once the circulating fluid is heated, it can potentially stay hot for hours, enabling a steam power plant to keep churning out kilowatts long after the sun has set.

…An Exaggeration

Despite a barrage of criticism, the US Department of Energy began promoting concentrating solar power as a showcase for American clean energy know-how all through the Obama administration. The Energy Department continued to carry the torch for additional technology improvements during the administration that followed the Obama administration and has since been replaced by the Biden administration. The projects included some interesting moves in the area of supercritical carbon dioxide and other innovations aimed at enabling solar energy to compete mano-a-mano with fossil energy for control of the nation's power grid.

That's all well and good for decarbonizing the electricity generation business, but it still leaves the area of industrial process heat wide open.

Earlier this year, the Energy Department's National Renewable Energy Laboratory ran the numbers and outlined the need to do something about industrial process heat, such as paper mills and other industrial processes that require heat.

"Fossil fuels account for about 87% of all manufacturing fuel use in the United States, which is essentially the same as four decades ago," NREL observed, emphasizing the need for a strategic approach.

Somewhat ironically, a good deal of that manufacturing fuel use is related to petroleum refining. Based on figures from 2014, NREL estimates that the petroleum industry is by far the most significant user of fuel for industrial process heat, clocking in at 2-1/2 times the next largest user.

Counting down from petroleum refineries in order of size, NREL ranks the largest industrial process heat users as paper mills (except newsprint), paperboard mills, iron and steel making, basic chemical products, and ethyl alcohol production. Together with petroleum, these sectors account for about half of all industrial process heat used in the US.

New Life For Concentrating Solar Power

Among other solar technologies, the new NREL report indicates that concentrating solar

systems that deploy parabolic trough collectors could be the key to an efficient strategy for decarbonizing industrial processes.

“PTC technology, when combined with thermal energy storage (TES), not only has the largest opportunity in terms of distribution over geography and time, but also in terms of applicable IPH demands,” NREL enthuses, adding that “PTC with TES represents the displacement of nearly 2,500 trillion Btus of combustion fuels, which corresponds to 137 million metric tons of CO2, or about 15% of all industrial combustion CO2 emissions.”

All this is by way of saying that improvements in parabolic trough technology could make a significant dent in emissions from industrial energy users.

That’s where the new aerogel comes in. Last week, the University of Michigan announced that it is deploying a $3.1 million in Energy Department grant towards the development of a new “solar-transparent aerogel” for use in trough-style concentrating solar power plants.

“Parabolic trough power plants, currently the most widely deployed solar thermal technology, use a sort of mirrored halfpipe to concentrate sunlight onto receiver tubes carrying a circulating fluid. That fluid absorbs heat and transports it for storage or use — generating electricity or producing fuels and other chemicals,” the school explains.

The problem is that conventional trough-style systems don’t heat the circulating fluid high enough to power many industrial processes. With the help of special coatings they can get to about 1,000 degrees Fahrenheit, which enables them to cover some industrial use cases, but many more remain untouched, which explains why researchers have been on the lookout for aerogels and other new coatings that are more durable and more efficient.

A Love Letter From NASA To Earth

Considering that the US dominated the early years of the global solar industry through its space program, it is fitting that the University of Michigan research team has been inspired by the ceramic aerogels used in the Space Shuttle.

An aerogel is an extremely lightweight, porous material. Clays and polymers are among the materials commonly used in making aerogels. To get a full picture of what’s going on with

aerogels, though, NASA invites you to imagine making gelatin from powder and water, then removing all the water but enabling the gelatin to retain a solid form and structure — without the wiggle, that is.

Both NASA and the Energy Department are very interested in aerogels due to their superior insulating qualities, which explains why they have shown up on the exterior of the Space Shuttle, among other uses.

The trick is to let in the most sunlight for the most effective heat gain, while preventing the most heat from escaping. The team has been working with the firm AeroShield Materials to develop its new transparent aerogel tiles, which are sized for use in a standard four-meter parabolic trough.

Durability also comes into the picture. With an assist from the company Forge Nano, the aerogel tiles sport a special, atom-thin coating that prevents them from degrading or cracking under high heat.

The team is confident that the new aerogel will enable parabolic trough solar power systems to heat a circulating fluid up to 1,300 degrees Fahrenheit. They also envision a modular, scalable system that could be deployed widely across industrial sites.

Next Steps For Concentrating Solar Power

With the new funding in hand, the team will be able to construct a pilot scale demonstration system. The plan also includes developing manufacturing strategies that boost efficiencies and lower costs.

In addition to the $3.1 million for the demonstration model, the team also won an Energy Department grant of $300,000 aimed at identifying materials that provide for an even more effective balance between heat gain and heat loss for in concentrating solar systems.

It looks like the solar industry is about to enter the Age of Transparency. In addition to transparent aerogels for concentrating solar systems, photovoltaic technology is getting a transparency makeover, too.

Read the original article on CleanTechnica.