SOLAR FOAM ROOFING

SOLAR FOAM WHITE PAPER

Solar Foam Roofing

New Rooftop Solar Mounting System

"Designing how a building operates will determine its energy usage, thereby making the most substantial impact on its overall energy efficiency. With this in mind, both planned or new construction and existing buildings are more frequently opting for, or switching to, solar power as a supplementary source of energy"

Edwin James
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Solar Power

Solar power is the result of solar energy which is captured from sunlight and converted into electricity which is either stored in batteries for use at a later date, or diverted directly to the building for immediate use. In some cases excess energy may be sold to "the grid" for additional income or to supplement and reduce the standard energy that may be used from existing power sources. Commonly, this process is accomplished with photovoltaics (PV), a device which converts sunlight into electricity through the utilization of materials that produce electric current when exposed to light (a phenomenon known as the photovoltaic effect). Small electrical devices called PV cells, or solar cells, carry out the PV process. Solar cells are arranged in arrays called solar panels, or solar modules, that are mounted on a stand or bracket and installed in an area with substantial sun exposure. Typically, several solar panels are connected to form a PV system, or solar power system, that is utilized to provide some or all of a building's energy needs.

Stats and Figures

- Roughly 170,000 TWh of solar energy strikes Earth continuously
- About 50% of solar energy reaches the Earth's surface
- Global energy consumption is roughly 18TWh
- Solar energy exceeds global energy needs by a factor of over 4,700

Benefits

Lacking any toxic or global-warming byproducts, solar energy is the cleanest and most abundant of any currently known energy source, and as noted above, more solar energy reaches the Earth's surface in a given moment than could ever be used. Also, solar power offers energy independence by allowing buildings to consume electricity where it's produced, thereby decreasing their dependence on the grid. Currently, depending on the assemblies chosen, PV systems may cost more at the time of installation than simply hooking up to the grid but, the investment can be recovered with energy savings alone, and there is also the potential to sell excess electricity to utility companies. In addition, as technologies improve in the field of PV and PV panels, the cost to energy generated values continue to decrease, reducing the cost of the system.

Solar Power Technology

Solar PV systems that produce the fastest payback and highest ROI are the key to long-term solar success. Mechanically attached racking systems ensure lower maintenance costs over the life of the solar arrays, delivering the lowest-cost electricity. Once building owners and solar contractors begin to fully appreciate the higher lifetime cost of maintenance associated with ballasted racking systems, the solar installation industry will rely on mechanically attached racking systems. This inheritably creates another issue; massive amounts of new penetrations in the roof membrane and deck substrate.

The solution is the Monolithic Solar System that incorporates low rise sprayfoam adhesive with high density sprayfoam roofing to create a racking solution with a distributed load across the area. This will result in additional opportunities for more building owners to capitalize on their rooftop real estate. Like the mechanically attached racking systems it offers the same lower maintenance costs over the life of the solar arrays, delivering the lowest-cost electricity.

PV systems certainly aren't the only way to capture solar energy, but they are basically the only game in town for commercial buildings when considering space and the amount of energy generated by other systems such as wind driven systems. In the past few years, two important trends have revolutionized the implementation of PV systems.

First, solar panels are significantly easier to install now than they were five years ago, with much of the progress being attributed to more installer-friendly mounting systems and refined installation procedures.

Second, and most important, the price of solar panels has dropped to roughly 20% of what they cost just a few years ago, primarily due to significant investments made by China creating more efficient PV panels. Also, there are considerably more financing options available to prospective customers, as well as rebates offered by some power companies and federal tax credit to offset the cost of the PV systems. These trends have resulted in lower barriers to entry for businesses looking to incorporate PV systems into their buildings.

It should be noted that a third trend, solar cell efficiency, is also very important. Solar cells are steadily, albeit slowly, becoming more efficient. While the increasing efficiency of solar cells offers small (for the time being) but tangible long-term returns, the advances aren't as drastic as the improving affordability the panels themselves.

Solar power is an enticing option when it comes to saving energy, but there is one practical problem: PV systems can potentially negatively impact the structural integrity of the roofs on which they're installed. Specifically, the installation of solar panel stands, which involves mechanical fasteners (screws), compromises the roof decking through countless holes. One way to avoid this conflict is to eliminate mechanical fastening entirely and opt for fastening the solar panel stands with what is known as a Non-Penetrating Mounting System. Ballasted systems should not be considered for numerous reasons, but primarily the undistributed weight load and low resistance to movement in high wind environments causing wind-uplift and thereby unwanted movement of the racking system creating a "creeping" effect.

Monolithic Solar Systems

PV systems that utilize Non-Penetrating Mounting Systems, called Monolithic Solar Systems, are a combination of a solar power system and a de facto spray foam roofing system, Solar Foam Roofing. Basically, solar panel stands are adhered in place and then fastened with spray polyurethane foam (SPF). Even though the spray foam's primary purpose is fastening the solar panel stands, the SPF roofing system actually compliments the PV system very well. Essentially, a spray foam roofing system can reduce the overall energy needs of a building, thereby facilitating the PV system in providing a greater share, if not the full share, of a building's energy.

Ballasted Mounting System

Mechanically Attached System

Monolithic Solar System (Patent Pending)

Installation Overview

Monolithic Solar Systems blend the installation procedures of PV systems with that of spray foam roofing systems.

First, as with any SPF roofing installation, the roof must be inspected for damage, repaired if necessary, and cleared of debris.

Next, the installation process veers from that of a typical SPF roof with the placement of the solar panel stands. When the stands are positioned according to project specifications, they are set in place with low-rise foam adhesive applied to the bottoms of the stands' posts.

After the stands are situated, spray foam can be installed as described previously: detail work, flat areas, and flashing. Within the scope of the detail work is a particular emphasis on installing additional foam around the posts of the solar stands. Foam is sprayed above the grade of the roof, covering the lower portion of each post.

After the foam has cured, the protective roof coating is installed, and when the coating dries, the panels can be installed on the stands. It's important to note that the density of the installed spray foam should be high enough to withstand foot traffic for the PV panel installation and periodic maintenance (generally speaking, foam in excess of 2.5 lb./cu. ft. should work).

Properties and Benefits of Monolithic Solar Systems

Structural Integrity

Of course, as stated above, the main benefit of a Monolithic Solar System is that non-penetrating mounting system maintains the structural integrity of the roof. With traditional solar power systems, mechanical fasteners can number into the thousands, depending on the number of panels, which means thousands of holes in the roof decking and a greater potential for leaks. Also, mechanical fasteners create point loads on the roof, rather than spreading the load across the roof surface, which is how roofs are designed to support loads (e.g. from snow or rain).

With a Monolithic Solar System, there are no holes in the roof deck, which assures a leak-free roof. Also, because the entire roofing system is securing the solar panels in place, the non-penetrating mounting system a more robust fastening method than screws.

Durability

Spray foam provides a monolithic membrane across the entire roofing surface because, unlike other roofing materials, it is seamless and penetration-free. Additionally, spray foam roofs are self-flashing, which, in conjunction with their monolithic nature, results in a completely leak-free roofing system. Without the potential for leaks, SPF roofing systems are inherently durable, with service lives lasting decades.

Another benefit of spray foam, lightness, becomes apparent when comparing it to roofing systems that use ballast. Ballast systems, which use aggregate or rocks, can put tremendous loads on roofs. Also, during high wind events, the ballast may become projectiles and cause damage to properties in the vicinity of the roof. With spray foam, excessive weight and projectile potential are never causes for concern.

Additionally, SPF roofs are also sustainable roofing systems, in the sense they do not need to be replaced as frequently as other roofing system, but rather simply recoated. Also, in the case of damage, spray foam roofs can be touched up with additional foam and coating.

Energy Efficiency

Another major benefit is the fact that spray foam helps the PV system meet a building's energy needs, as SPF is an extremely robust insulating material with high insulation value (R-value). Spray foam's insulating properties prevent heat that radiates onto a roof surface from transferring via conduction through the roof decking into the interior space of a building. This characteristic alone reduces the load on HVAC systems to maintain indoor temperatures, and thereby reduces energy consumption and utility bills.

Additionally, SPF roofing systems are always installed with protective coatings that are often white or light-colored, which reflects much of the sunlight that hits the roof surface. With high reflectance properties, there is less heat transferred into the roof surface, which amplifies the energy-saving benefits provided by the insulation value of spray foam.

ROI

One unavoidable fact about PV systems and spray foam roofing systems is that they're often considered to be costly or high-end alternatives to other power and roofing systems. In reality, the upfront costs of these systems–however more they might be–can be recouped as they perform over the course of their service lives, such that they offer an enticing return on investment (ROI). The notable benefit of a Monolithic Solar System, in terms of ROI, is that the spray foam reduces the amount of energy that a building needs to operate, as noted above. Therefore, the PV system is better able to provide for the building's energy needs. With the SPF roof complimenting the PV system so well, Monolithic Solar Systems can offer an expedited ROI.

Case Study: Polypack Inc.

With a keen eye on lowering energy expenses, Polypack Inc. sought to install a solar power system on the roof of its coastal Florida facility. However, ownership was wary of how the system, with its thousands of screw holes, would impact the structural integrity of the facility's 50,000 sq. ft. roof–a crucial concern in a hurricane-prone area. The only option for Polypack was installing a uniquely designed PV system with a non-penetrating mounting system.

Case Study: Polypack Inc. (continued)

Monolithic Solar System.

Before the Monolithic Solar System could be installed, the design had to be tested to ensure it conformed to building codes. A third-party testing lab from Miami performed pull-tests in accordance with Miami-Dade Standards. The test procedure was fairly involved. First, a stand was affixed to the roof surface with low-rise foam and roofing foam. After the foam cured, the testing team used a specialized apparatus to gauge the strength of the foam's hold. When all was said and done, the system withstood a pulling force of nearly 6,000 lb./sq. ft., which was cut in half to nearly 3,000 lb./sq. ft., per Miami-Dade Standards. In any case, the strength of the system well exceeds even that of mechanical fastening via screws.

With testing passed and the plan set, the facility's roof was inspected and a couple of areas received minor repairs. The solar panel stands were then placed in their specified locations. A roofing contractor was brought in to install the SPF roofing system, while an electrician was later brought in to install the solar panels.

A major goal of the project was being able to track performance of the PV system. Polypack wanted to know how much electricity was being produced by the entire system, of course, and also how much each individual panel was contributing, as the company purchased several different types. Since the system was installed, it has become evident that the panels all perform roughly equally, regardless of whether they're pricey panels produced in the U.S. or less expensive panels from China.

The complete system including the mounting qualified for the Federal 30% tax credit and accelerated depreciation in five years. The system produced about 80% of the facility's electricity in 2014–a rainier-than-average year–and Polypack is expecting a payback period of less than six years.

Total KW Used: 548,686.7 KW
Total KW Generated: 435,542 KW
Total KW Purchase: 113,144.7 KW
Percent Generated of Usage: 79.4 %

Annual Value of Generated Power:

$58,798.17

System ROI: 5.7 years

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