Patented control system: The DEGERconecter identifies the strongest light source at any time of day.

DEGERtraker: The single and dual axis fastening system ideally aligns the photovoltaic modules.

Up to 45% more energy gained using the DEGERconecter

Intelligence designed by Nature. Solar tracking systems from DEGERenergie exactly align each individual solar module to the most intense light source – whether the sun is shining or it’s heavily overcast. An impressive energy gain of up to 45 percent.

**BENEFIT FROM THE KNOW-HOW OF THE MARKET LEADER**

▶ Best price-performance ratio – therefore a fast payoff
▶ 45,000 DEGERtrakers on the grid
▶ Lowest transport costs
▶ Most clever control unit
▶ TÜV tested and certified, UL/CSA tested and certified
▶ Total security – Ask for our “Spare Care”

Tracker efficiency should always be measured by the yield

Solar Power International: hopes rest on the US market

This year, the Solar Power International conference for the first time chose its location outside of California – in Dallas, Texas. At a time of high controversy between Republicans and Democrats over the effectiveness of loan guarantees to establish manufacturing in the US and to speed up installations of renewable energy generation facilities, the conference comes at a critical point for the US solar sector.

Pages 126, 132, 136

Solar paint: by machine instead of by hand

The history of paints for solar absorbers is at the same time a history of processing technology. While at first, they were painted on by hand by hobby enthusiasts, they have now for many years been applied with spraying machines by collector manufacturers. Recently, they are produced using industrial strip painting processes. S&WE presents solar paints, their developers and manufacturers.

Page 84
The paint sprayers move along the absorber. While they move up and down, black paint flows from their nozzles. As soon as they have pre-sprayed the metal plate, a conveyor belt transports the next absorber into the painting machine from SunEarth Inc. “In sunny regions of the USA and across the world, these absorbers are fully sufficient in order to produce hot water. No expensive, highly efficient absorber layers are required”, explains Sales Manager Peter Bliss, when asked why the US manufacturers produce absorbers with less efficient paint coatings alongside collectors with selective absorbers.

The paint sprayed by the automatic paint sprayers in the SunEarth machine is supplied by the US company Solec-Solar Energy Corp. With degrees of absorption of up to 94 %, it can compete with galvanic and vacuum coatings. With emission levels of between 20 and 49 %, it emits far more heat than the selective competition, however, among which the radiation emission levels lie between 5 and 8 %. The Solkote solar paint from Solec has so-called semi-selective properties, however, and thus outperforms simple black paint with emission levels of over 90 %.

Low costs as an argument for solar paint

Selective absorption coatings serve two purposes: they should absorb sun rays as efficiently as possible, convert them into heat and lose as little of this heat as possible. They can fulfil these purposes well when they have two properties. First, they should absorb a large share of the short-wave sun radiation, i.e. they should have the highest possible degree of absorption. Since the absorbers heat up during this process and reach higher temperatures than the surrounding environment, they would re-emit a large share of the absorbed solar energy as long-wave heat.
Manufacturers of solar paints and solar paint absorber coatings

<table>
<thead>
<tr>
<th>Company</th>
<th>Product name</th>
<th>Product type</th>
<th>Start of production</th>
<th>Absorptance [%]</th>
<th>Emittance [%]</th>
<th>Coating process</th>
<th>Absorber material</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alanod-Solar GmbH &amp; Co. KG, Germany</td>
<td>mirosol TS</td>
<td>painted absorber material</td>
<td>2010</td>
<td>90 ± 2</td>
<td>20 ± 3</td>
<td>coil coating</td>
<td>aluminium</td>
<td><a href="http://www.alanod-solar.com">www.alanod-solar.com</a></td>
</tr>
<tr>
<td>Hydro Aluminium Rolled Products GmbH, Germany</td>
<td>HySelect</td>
<td>painted absorber material</td>
<td>unavailable as yet</td>
<td>90</td>
<td>12</td>
<td>coil coating</td>
<td>aluminium</td>
<td><a href="http://www.hydro.com">www.hydro.com</a></td>
</tr>
<tr>
<td>Transfer-Electric GmbH, Germany</td>
<td>Solarlack M 40 Li</td>
<td>paint</td>
<td>1975</td>
<td>95</td>
<td>86</td>
<td>spraying</td>
<td>metals, plastics</td>
<td><a href="http://www.transfer-electric.de">www.transfer-electric.de</a></td>
</tr>
</tbody>
</table>

1 depending on dry film thickness, substrate and surface preparation

Source: company data, own research

radiation. The absorber coatings must therefore secondly have a low degree of emission for this wavelength range, or in scientific terms, they must reflect infrared radiation as effectively as possible. Selective coatings unify a high degree of absorption for the sun radiation with a low degree of emission for heat radiation.

Solec President Bob Aresty argues for solar paint less on the basis of the visual properties than with the low costs and many years’ experience. “Solkote greatly improves absorber efficiency and reliability over standard painted absorbers. Its durability, efficiency and reliability have been proven on over 15 million square feet of installed systems since 1982.” Applied costs of US$ 1.60/m² could be easily achieved. “Solkote is easy to use and requires minimal capital investment for application equipment. It is shipped premixed and ready for use. Standard air atomization spray equipment, available worldwide, is all that is required for applying this durable, low cost selective surface, and it has excellent shelf life of at least one year from date of manufacture”, he says, listing further advantages of his product. Metal oxide pigments, not described by the manufacturer in greater detail, provide the absorbing properties of the solar paint. Xylols and aromatic hydrocarbon materials act as solvents, and a silicon polymer is used as a binding agent.

However, at SunEarth, it is not only for production process reasons that automatic paint sprayers are used for spraying the mixture onto the absorbers. The visual properties of the solar paint depend on its
Solar thermal

Solar Paint

Microscopy of a thickness insensitive spectrally selective paint: the very thin upper layer consists of packed pigment particles as solar radiation absorbing layer. The particles are linked with a small amount of binder. The thick layer of stacked aluminium flakes serves as infrared reflecting layer.

Photos (2): Aventa

thickness. The thicker the paint, the poorer the effect, since this reduces the effectiveness of the infrared reflecting properties of the metal absorbers which ensure low emission. According to a product brochure produced by Solec: “Wet film thickness of 0.020 to 0.025 mm and careful cleaning of substrate will yield optimum results”.

Two approaches to solar paint

The pioneers of solar heat technology coated the absorber with simple black paint. In the 1970s, enthusiasts in Europe, who often built their collectors themselves, were then able to use products such as the solar paint produced by Transfer-Electric GmbH, which offers better absorption. Since the 1980s, manufacturers can enjoy the advantages of Solec, a product that offers low emission levels. In the 1990s, the scientist Boris Orel at the National Institute of Chemistry Slovenia in Ljubljana began to develop new solar paints and semi-selective colours which had even lower emission values. Here, he worked with resin from phenoxy or silicon, for example. He used organic black carbon or calcinated iron oxide FeMnCuOx as pigments.

“There are two ways of making paint selective. One way is to make a thin compact coating of only 1 or 1.5 µm thickness with a high pigment loading which is black. As it is very thin, it does not emit thermal infrared radiation. The low thermal emittance is provided by the low emitting aluminium or copper substrate. You can secondly produce 20 to 30 µm thick coatings by incorporating metallic flakes inside the paint”, explains Orel. He refers to the paint produced using the second method as thickness insensitive spectrally selective coating, TISS in short, while the first is known as thickness sensitive spectrally selective coating (TSSS). “Sensitive means that if you put too much paint e.g. on aluminium you screen the low emittance of the metal.” For this reason, precise production methods such as coil-coating or automatic spraying are necessary when producing the coats.

The effort bears fruit in the form of higher selectivity of the TSSS paints. Orel explains: “A flat aluminium plate on which you put a very thin coating obtains more favourable emitting values than aluminium flakes in some organic binder because the flakes are not all facing parallel to the sky so the reflecting effect is not as good as with flat aluminium.” By contrast, TISS colours are less difficult to produce. They offer three further advantages: since they are applied with a higher coat thickness, they are more resistant when exposed to the atmosphere, and are therefore suitable for uncovered absorbers. With these colours, the black colour pigments can also be replaced by other colours, so that coloured paints can be produced with similar visual properties. Thirdly, they can also be coated with plastics, as well as metals. The Norwegian company Aventa AS is currently testing TISS paints for its plastic collectors.

Strip painting machines for solar absorbers

For several years, the paints developed by Orel have been produced by the Slovenian company Color d.d. Since 2004 Color is a part of Helios group that is one of the 20 largest paint manufacturers in Europe. The company delivers paints to Alanod-Solar GmbH & Co. KG. Since last year, the German coating company has been marketing a paint coating called Mirosol TS alongside
its vacuum coatings. It is the only company worldwide with this kind of an automatic production for painted absorber material. “It is specifically designed for southern European countries, where highly selective surfaces are not necessarily required, and where for price reasons, it is simpler to enter the market with low prices qualities”, explains Sales Manager Wolfgang Peters. Alanoq-Solar rolls the TSSS paint with a strip painting machine on aluminium strips. Then, they pass through a 50 m long flotation oven for drying. The machine is used by the company to check the thickness of the paint coating in the necessary area.

From next year, Hydro Aluminium Rolled Products GmbH is also planning to offer pre-painted aluminium absorbers for the solar heat industry. The Hyselect selective paint coating was already presented by the company at the Intersolar 2010. After aging tests failed to deliver satisfactory results, however, the hydro scientists had to change their coating structure once more. Hydrochemist Andreas Siemen is confident that the new Hyselect coating will do better in the test. “Among ourselves, we refer to the coating as paint which is made of purely anorganic substances. However, this is not just any conventional paint. It cannot be simply sprayed, painted or rolled on. You need to be familiar with a few procedural tricks and to know how to produce and dry it, and how to make it stick”. For this reason, Hydro plans to produce Hyselect using its own strip painting process.

Joachim Berner

Coloured paints: extruded samples of polyphenylene sulfide (PPS) twin-wall sheets as collector absorber provided by Aventa