Photos: Dow Corning

Rogier Reinders leads a team across multiple European markets for specialty chemicals.

Silicone and glass-glass PV modules

Interview: In the new environment of crushed prices, quality and durability are as important as ever as a means for PV module makers to differentiate their product. In light of these factors, Rogier Reinders, Head of Marketing for Europe at Dow Corning, has provided **pv magazine** with some insight into the advantages of silicone as a key material in glass-glass PV modules.

pv magazine: ***What are the primary advantages of silicone as an encapsulant versus EVA?***

Rogier Reinders: It is interesting to note that the early PV modules were actually using silicone. That was in the '80s, and by the end of the decade silicone had been substituted for EVA. The reasons for this were processability and cost.

What we see now that costs have gone down is an emergence of more robust, more durable modules. Which means longer lifetime, and also use in Sunbelt regions or longer lifetime utility types of applications. For those, what we propose is a special silicone, which is an optically clear silicone, with a good durability. The advantages of these silicones is that they lead to higher durability and longer lifetimes, which means that panel makers are able to give longer lifetimes to their modules. That is really a stamp of proof of the durability and reliability.

Now why is this? One reason is that the silicone as a material, purely because of its chemical strength, mainly the silicone to oxygen (Si-O) bond, is so strong that there is no discoloration or degradation happening. And that leads to lower losses. Data from the EU Joint Research Center shows what that advantage is: A higher power output at the end of the day, which is worth money. So increased reliability can bring major financial benefits.

There are also some processing advantages, particularly for glass-glass modules. They have to do with ease of applying the material versus films, specifically for the glass-glass modules, and also the de-airing of a liquid material is much easier during lamination than what we have with EVA.

With all of those elements together, you also see the result with aging. Silicone encapsulated modules pass standard climate chamber tests, but also extended aging tests in climate chambers. What we see there are lower degradation values. Those really sum up the advantage. We see the silicone, together with the glass-glass module structure as a combination of excellence. We are very happy that glass-glass is getting more traction in the market.

I remember five years back; people were talking about glass-glass modules, doubting their viability because of the cost of the rear glass. Is it going to happen, or not? We do think it is happening and we clearly see the signs of that.

What kind of module lifetimes are you seeing?

The question is to compare to EVA. Standard EVA modules have a 25 year lifetime. The glass-glass modules are not as easy to make, but what we see is that manufacturers claim a 30 year lifetime. And for silicone, the latest ones that we have seen are 40 years.

But what does module lifetime mean? It means a specification of 20% or less power degradation over the lifetime. So we see manufacturers claiming at least 10 years more performance under warranty than what we see in the market right now.

You touched on the silicone oxygen bond. Can you go more into the physical properties of silicone, and of this bond?

This product is a silicone elastomer. We provide that as a two-part system, like an EVA film, and it is applied in a liquid form. So the product form is different, and that difference gives some advantages in terms of de-airing, which is especially important for glass-glass modules.

I believe that the glass-glass module would essentially have some advantages. The whole setup of the module is more attractive and there will be less moisture ingress from the back. The

Module manufacturers are taking an interest in Dow Corning's development of silicone as an alternative encapsulant to EVA.

glass-glass module has less mechanical stress, because the cells are exactly in the middle of the two glass panes. With a backsheet glass module, that is a little different. Cells are exposed to more stress.

The silicone is essentially in a liquid form: the transparency, the strength of the bond, the two parts, and the fact that you have to apply it by dispensing rather than by cutting and placing the film. There is a dispensing process that is easily automated. The typical advantage of silicone is the resistance to UV – there will be less discoloration and very constant mechanical properties over the lifetime of the material. We also see stable performance against moisture and temperature swings, so it is a very robust material.

We see that in construction, where the tallest buildings in the world have glass bonded to the racks of the building with silicone adhesives, or in the car industry, where you really see big temperature differences, and we also see it in the lighting industry. Most of the highest performing LEDs also have a transparent silicone layer over them. It is a molecule that is very stable throughout its lifetime.

How has the reception been among module manufacturers to a return of silicone in glass-glass module designs?

Within the top 10 module makers, a few players either buy silicone for making glass-glass modules or are looking into this kind of technology. I think Dow Corning has been the only one to have substantial commercial success in this field.

With EVA, it is not always easy to process glass-glass modules, silicone can be an enabler for that. It is very important to have an offer in the process side. We need to be able to offer a processing partner or a processing solution. It does not matter so much so long as there is a professional processing offering along with the material. Because without that, customers are on their own – and that is not what we want.

It is not a material-only offering that we want to bring, and I believe that part of the success we have already had is related to the ecosystem approach we offer to customers, as well as the material itself.

I believe Dow Corning has been on this path of silicone encapsulation as one of the first, in the '80s, but also one of the first in the early 2000s, and we have stayed on it the longest – we have been resourcing it the longest and we are still behind the technology, and are also expecting growth, now that the lifetime of the modules is becoming more important.

We sometimes see reports of severe module degradation in PV parks for standard modules. I imagine that will open the eyes of some of the players in the field to these kinds of technologies as well.

Why do you believe that, as you suggest, glass-glass modules are becoming more popular?

This is a system-related point. I believe there are a few reasons. One is bifacial module technology – people are very interested in this – and clearly it can't be done with a backsheet. Glass-glass modules, including the ones that we have on our building right here [at the Dow Corning office in Brussels], have no frame. Frameless designs can save quite a bit of money. We can actually glue, and we have done that here on our building, glass-glass modules to a rack with glues. That saves quite a bit of money, and it saves the total frame as well. ◆

Interview by Christian Roselund