Earth first: greening the PV industry with a universal zero waste recycling concept!

In this day and age recycling should be a top priority throughout the renewable energies sector. Dr. Palitzsch from Loser Chemie GmbH, reminds PES readers about the latest update to the EU waste legislation. It's remarkable to see how it is possible to achieve total recovery of all materials, in both thin-film PV and silicon-based modules.

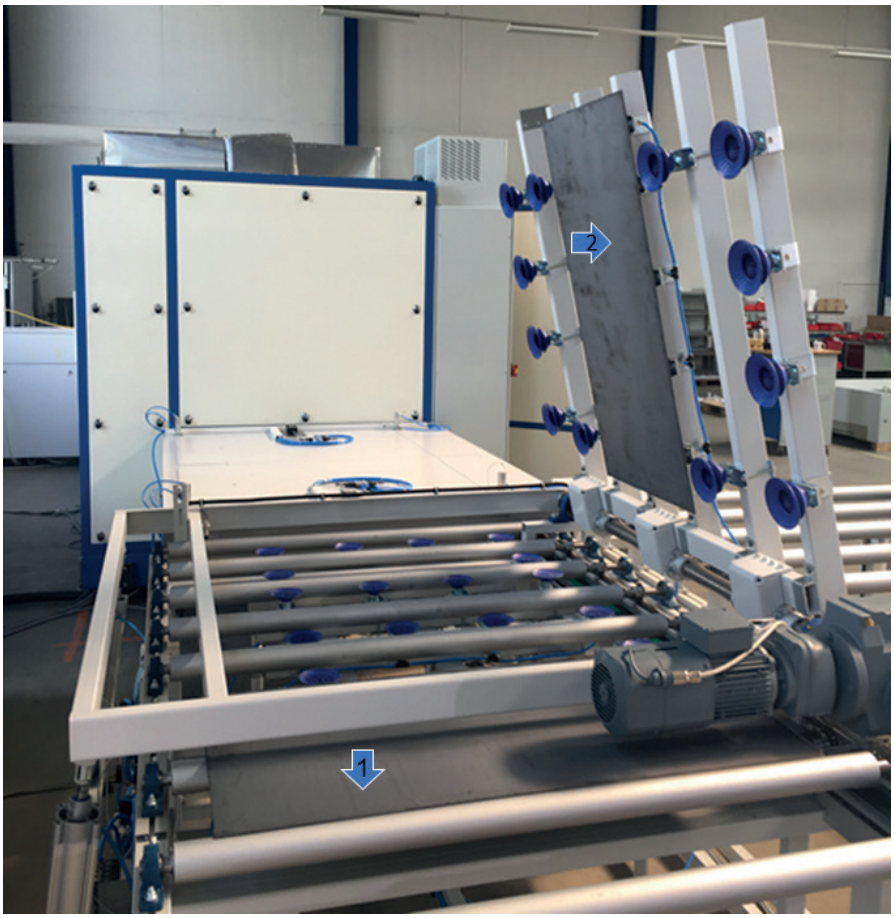

Fig 1. Separation of front (1) and rear glass (2).

According to the latest revision of the EU waste legislation (WEEE), producers of solar photovoltaic panels are responsible for the disposal and recycling of the modules they sell in EU Member States. In addition to this we also have a few other reasons to recycle all and any used materials.

Recycling allows the materials, in otherwise one-use products, to go on to become something new and saves resources involved in sourcing new materials: that´s why it is amazing. And the best way is, of course, the complete recovery of all components.

In recent years, Loser Chemie GmbH has led the search for a universal concept, for as many solar module types as possible. Today, the company has introduced a technology that enables the recycling of both thin-film PV and silicon-based modules. An important role is played by light and water. Used correctly complete disassembly of old solar modules, into their individual components, is now possible.

First of all, the application of optical technologies means the sandwich structure is easy to open and the glass panels do not have to be destroyed.

This is important, because the price for recycling depends primarily on how much money can be generated for secondary raw material glass. This is also the decisive criterion for the choice of recycling. Usually two different grades of glass are used in one thin film photovoltaic module - front glass and rear glass (see Fig. 1). The front glass is of high quality, because it is also contains no iron. It is obvious, that a pure-grade secondary material of front glass has a higher value than the ferrous back glass.

Contrary to conventional technologies, like shredding, we do not break the glass. By using technologies from the field of optical

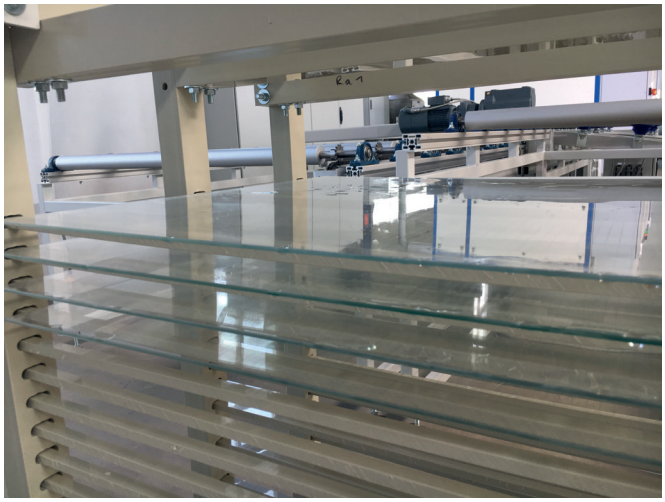

Fig 2. Cleaned and sorted PV glass after treatment.

Fig 3. Example of an undamaged, cleaned Si-PV zone (7).

Fig 4. EVA from recycling process

nanotechnology it is possible to open fully the sandwich structure, without damaging the glass.

To clean the glass panels we use alkane sulfonic acids, which without fail can extract all photoactive layers from several metals, in a very short reaction time. Our hydrometallurgical extraction operates at room temperature and the used alkane sulfonic acid is totally biodegradable (OECD 301 A). As a result, sorted pure glass is obtained (see Fig. 2).

If necessary, it is even possible to pull off the plastic film immediately after the wet-chemical treatment of the rear glass.

This method is universal and is also used for the recycling CdTe, CIS, CIGS, GaAs etc.

The alkane sulfonic acid is used as a solvent, which can be recovered. This process also works for silver without the formation of nitrous gases, which normally happen in the field of silver recovery, when nitric acid is used.

The optical method is very suitable for separating double glass modules that have a dark absorber layer. By contrast, most silicon PV modules consist of a glass pane and a plastic composite. For these types of modules, the process of separation by light is not so easy.

In many places, the light is not an extraneous factor. Loser Chemie developed a new process to solve this problem. It is possible to separate the layers of a PV module using water. In Fig. 3 you can see a treated and an untreated area of an Si-End-of-Life module. The glass is completely undamaged and you can see that the busbars are isolated too.

Finally, EVA (Fig. 4), Tedlar (Fig. 5), silicon/silver/aluminium particles (Fig. 6) and, of course, busbars are obtained as further results of the process.

The silicon grains can be treated with our proposed procedure: the chemical reaction between the back contact aluminium and the depleted aluminium-chloride solution is very simple and works better than the normal treatment with sodium hydroxide. We get a cleaner product as the material has been previously freed from contaminating metals: copper, tin and lead.

Finally the silver is dissolved with a biodegradable sulfonic acid and the silicon material is washed and dried. This material is very interesting as a secondary raw material for Fresitec GmbH, a 100% Loser Chemie sister company. Both are 100% daughters of the newly established L´FFICIENCY Holding.

Fresitec has set itself the goal of continuing and expanding the recycling activities of Solar World, at the former site in Freiberg in Saxony, Germany. The company has 20 years' experience in reworking, upgrading und recovering silicon in many forms and formats. Fresitec can take the yielded silicon from the recycling process and use it as feedstock. Their portfolio includes mechanical and chemical processes, as well as innovative crystallisation techniques.

Business developments started in November 2017 and now the L´FFICIENCY Holding group is very well positioned along the value chain.

Loser Chemie GmbH will be presenting recycling technology at Intersolar Europe 2018 in Munich and at the Intersolar NA 2018 in San Francisco.

Fresitec GmbH will present technologies around the silicon semiconductor material at the Semicon West 2018.

www.loserchemie.de

www.fresitec.de

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Fig 5. Separated tedlar from the recycling process

Fig 6. Yielded silicon, with residues of the silver and aluminium contacts