ECOLUX – Inexpensive, ecological, PV recycling

What to do with all the waste during processing and at the end of life? This is a question we often ask ourselves in the industry. Loser Chemie is developing high quality recycling technologies especially for the photovoltaic industry. Dr. Wolfram Palitzsch tells us more....

The Loser Chemie GmbH (LC) was a chemical industry whose main business was in water chemistry. In recent months, Mr. Loser has restructured his company. He founded a holding and sold the aluminium and barium chemistry sections. In order to build and run a photovoltaic recycling turnkey system he bought a plant engineering company - TESOMA GmbH.

Loser believes that you can only expect a first-class solution from a specialist. Thus Tesoma has established a reputation for providing precisely that, especially in the handling of flat glass. The company ranks as an international market leader when it comes to drying and fixing. Tesoma develops and manufactures their dryer systems in exclusive cooperation with JRT Photovoltaics. The highest precision and optimised processes allow mean minimal breakage when producing solar wafers. Partnering with qualified market leaders gives the competitive edge along with the highest possible potential for photovoltaic modules. This venture is bringing the Loser group closer to the photovoltaic industry.

The Loser group is developing a range of cutting-edge, environmentally friendly recycling technologies especially for the photovoltaic industry - for photovoltaic production scrap and end-of-life waste. The recycling of these wastes is important for environmental, political and economically. LC is aware that in the future natural resources such as water or metals maybe in short supply and therefore recycling is the most advisable end-of-life strategy and a way to save raw materials being wasted now.

It is undisputed that unquestionable benefits coming up with photovoltaic systems. The emission of greenhouse-gas from the manufacturing process is insignificant compared to the lifetime greenhouse-gas savings after installation and electricity production. This green electricity displaces our dirtiest energy sources. This is why the photovoltaic industry is undergoing remarkable growth. Global solar PV installations are soon expected to reach a cumulative capacity of 200 GW , which will see solar producing

more energy than 30 coal or nuclear plants combined and will help save over 100 million tons of the greenhouse-gas, CO_2, annually.

But every gigawatt of photovoltaic capacity represents up to 10 million photovoltaic panels, corresponding to billions of photovoltaic panels are already installed worldwide. Not forgetting that every PV panel will meet its end of life (EOL) someday and become PV scrap. There is a looming an invisible tidal wave of EOL-PV modules from homeowners and power plants, these will not show up for the next 20 years or so. That´s the expectation, but

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is not reality. It is not enough to make a graph showing installation forecasts from 25 years just because it is assumed that the modules will last 25 years. It is well known the high demand meant that some bought lower grade B or C modules at lower price despite visible defects. This and many other reasons explain the increased demand for recycling that we are experiencing. Apparently photovoltaic modules that have been installed for ten years or less are beginning to fail, showing delamination, hot spots, disconnected cells etc.

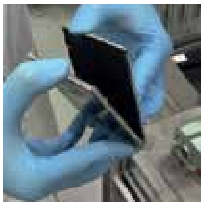
The efficiency has also changed over time and manufacturers have exited the market. This means that replacing defective modules may not be a seamless process even with warranties being honoured.

The need to address end-of-life issues early in the design stage of product is also clearly illustrated by the history of the electronics industry. Loser Chemie cannot afford to wait for the inevitable tidal wave of PV waste before beginning to address this problem and we already have to handle plenty of scrap now. Without economic and ecologic valuable recycling programs, defective and decommissioned (also EOL) solar PV equipment will enter the waste stream. It will end up in landfills (where toxic compounds can leach into groundwater) or incinerators (where burning can release toxic compounds into the air).

It is well known that a number of rare metals combined typically only represent 1% of the mass of a photovoltaic panel, their value is significant. Indium, selenium, tellurium, gallium, molybdenum, cadmium but also silver and silicon are some of the major elements used in these photovoltaic cells. But the biggest part of the waste consists of glass. This glass is an important secondary raw material. Why? 1 ton of cullet (picture 2) replaces 850 kg of sand, which would have to be quarried and when processing 1 ton of cullet less 255-300 kg CO_2 are emitted.

In addition a lot of energy is saved, since the melting point of glass cullet is much lower than the raw material mixture of sand, limestone and other mineral additives.

"We yielded a very high quality glass that can be used for float glass production"



So we focused at first on the glass because most of the thin film photovoltaic scrap is glass, see picture 1 for an example of thin film photovoltaic waste. The cost for the recycling depends primarily on how much money you can generate for secondary raw material glass. This is also the decisive criterion for the recycling route we chose. Usually two different grades of glass are used in one thin film photovoltaic module - front glass and rear glass. The front glass is of high quality, because it is also free of iron. This is obvious, that a pure-grade secondary material of front glass has more value as a mixture with the ferrous back glass. Contrary to conventional technologies, like shredding, we do not break the glass. Using technologies from the field of optical nanotechnology it has been possible to fully open the sandwichstructure, without damaging the glass, see pictures 3-6.

The semiconductor containing photovoltaic scrap has to be opened (see also picture 8) before the hydrometallurgical treatment starts because the semiconductor materials should become more accessible of a liquid.

It does not matter how big the pieces are at the end. For single-coated, large-area material such as foils or glass plates with evaporated metals or semiconductors, dipping in a bath is sufficient.

To resolve both the semiconductor and the silver we use a combination of organo-sulfuric acid (OSA) and hydrogen peroxide. Benefits in practical applications come, for example, from their non-oxidizing nature, the high solubility of their salts, the absence of colour and odour and the fact that they are readily biodegradable. Consequently, OSA's are becoming increasingly important in a number of applications and industries.

We yielded a very high quality glass that can be used for float glass production (picture 2) but also we are able to produce for example Indium from CIGS/CIS thin films (picture 7).

Loser Chemie is participating in the Intersolar and EU PVSEC, Munich (June 21-24, 2016) and exhibits at hall A3, booth 470. ■

www.loserchemie.de

[1] calculates Bundesverband Solarwirtschaft e.V. (BSW-Solar), http://www.solarwirtschaft.de/presse/pressemeldungen/pressemeldungen-im-detail/news/photovoltaik-200-gigawatt-installiert.html [24.04.2016]

[2] http://de.saint-gobain-glass.com/de/umwelt/waste-cullet.htm [28.04.2016]