

Wafer production for photovoltaics with Leister.

## Hot air boosts solar power.

Renewable energies are on everyone's lips. They are set to cover an increasing share of the energy mix in the future. Besides wind and water, photovoltaics (PV) is becoming ever more important among these renewable energies. A cost reduction in PV modules is also playing a significant role in helping photovoltaics to become more widespread. This is due to increasing unit volumes and continuous improvements in production techniques. One of the many steps in the production of PV modules involves drying the silicon wafers after cleaning. Here the drying time on the production lines of the Norwegian special machinery manufacturer Tronrud Engineering could be reduced thanks to the use of Leister air heaters. As a result, the entire cycle time for the production of PV modules could also be considerably shortened.

### Photovoltaics as an engine for growth

At the Norwegian machinery and plant manufacturer Tronrud Engineering, air heaters of the LHS product line from Leister are used for sensitive drying processes in the wafer proces-

sing. Tronrud is one of the largest special machinery manufacturers in Scandinavia. Amongst other things, the company is specialized in complete production lines for the production of silicon wafers. This segment of business has enjoyed above-average growth in the past few years, driven by rising demand in the photovoltaic market. Tronrud Engineering has developed into one of the leading suppliers to the world's largest wafer manufacturers. The Norwegians provide the PV industry with a broad spectrum of flexible production modules for various processes. These modules can be combined into completely automated production lines or – depending on requirements – also operated as stand-alone systems.

An example of an automated production line can be seen in the first picture, the "Wafer Inspection Line WIL". It carefully performs all steps from the sawn block through to the packed wafer. It therefore achieves an availability of more than 95 % as well as a fracture rate of under 0.5 %. – And that in a cycle time of one second per wafer!



Tronrud production line of the type WIL for the photovoltaic industry. (photo: Tronrud)

### Hot air as an accelerator

These impressive values can also be attained thanks to the drying technology used. After the obligatory fine washing of the individual wafers, the moisture is removed without trace in a drying tunnel. The wafer must be completely clean and dry for the downstream processes. First of all, part of the wash water is blown away before the tunnel using a sharp blast of air – also called an air knife. To prevent damage to the brittle material, it is important that the wafers – just 120 µm thin – are blown evenly on both sides. In the tunnel itself, hot air is then blown in. As a result, the remaining thin film of water fully evaporates. A continuous exchange of air in the tunnel is indispensable for a rapid drying process. As the air temperature is of crucial importance for a reproducible drying process, it is recorded in the tunnel via a thermal probe. A PIC controller is used to continuously adjust the heating power of the air heater.

### Broad spectrum of power

The air heaters of the LHS Line from Leister are ideally suitable for such demanding tasks. Heating powers from 550 Watt to 32 Kilowatt are covered with the various models in the LHS line (Leister Heat Sources). The LHS line is available in all power classes in the types CLASSIC, PREMIUM und

SYSTEM. They are primarily distinguished by their control capability. When it comes to the high requirements for thermal stability, as demanded by Tronrud for the PV industry, a device of the type LHS SYSTEM is the ideal choice. This can be controlled via a remote-control interface using an external PLC. That means the air heater can easily be integrated in a control loop feedback system. An air temperature of 100°C at a corresponding flow rate is required in the tunnel for the Tronrud drying module described. A Leister air heater of the type LHS System 60S with a heating capacity of six Kilowatts has therefore been used for this. As a result, the system achieves a maximum feed of 14 m/min. This corresponds to more than 3000 wafers an hour, or a cycle time of less than one second per wafer.

### Availability ensured

Not only the above advantages such as broad power spectrum and ease of control demonstrated by the LHS air heaters impressed the engineers at Tronrud. The good experience which system manufacturers throughout the world have reported when using Leister devices in the past few years is ample proof of the high standard of quality distinguishing the products of the long-established Swiss company. Leister has a close-knit network of sales and service points. The



*An air heater LHS 60 S from Leister supplies the drying module with the required heat at sufficient air throughput. (photo: Tronrud)*

international service is essential for the Norwegians. Thanks to this, they can ensure the high availability of their systems and production lines at all times.

**Even more efficient**

Besides air heaters, blowers and hot air blowers, Leister has recently added so-called air radiation heaters to its product portfolio (Picture 3). Air radiation heaters can be operated autonomously as infrared radiators, but have been specially designed for the combination of radiation with hot air. This combination enables an even more efficient and gentler drying process. The radiator heats the material evenly so that the liquid film evaporates. The hot air flow assists the evapo-

ration and conveys the moisture out of the processing room with the air flow. The first trials for drying PV wafers have revealed very positive results.

**A promising future**

Photovoltaics belongs to the future, no question. – Above all, if it succeeds in keeping the production costs as low as possible through high unit volumes and short cycle times. And also if the quality and reliability can continue to be guaranteed at the same time. With its air heaters and air radiation heaters, Leister supports this prospect of a prosperous future awaiting the photovoltaic industry.

*Leister is the first who offers the combination of an AIR RADIATION HEATER and hot air. This further accelerates drying processes. (photo: LHS 40 S and AIR RADIATION HEATER)*



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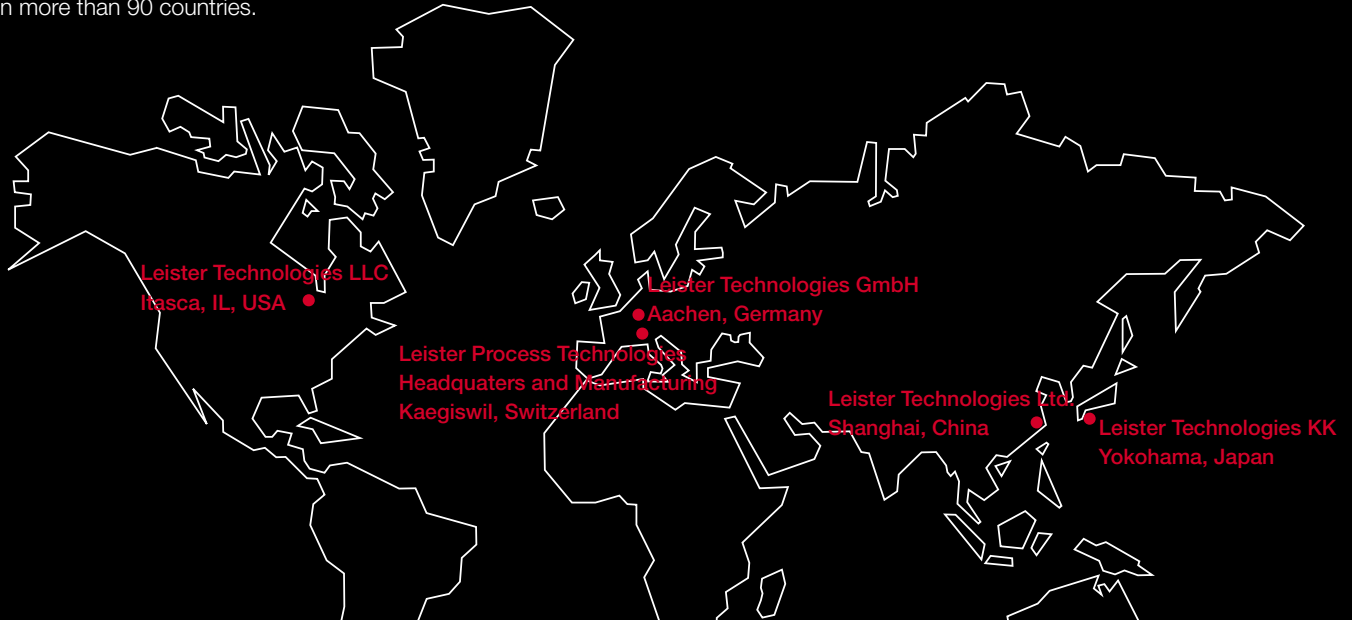
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