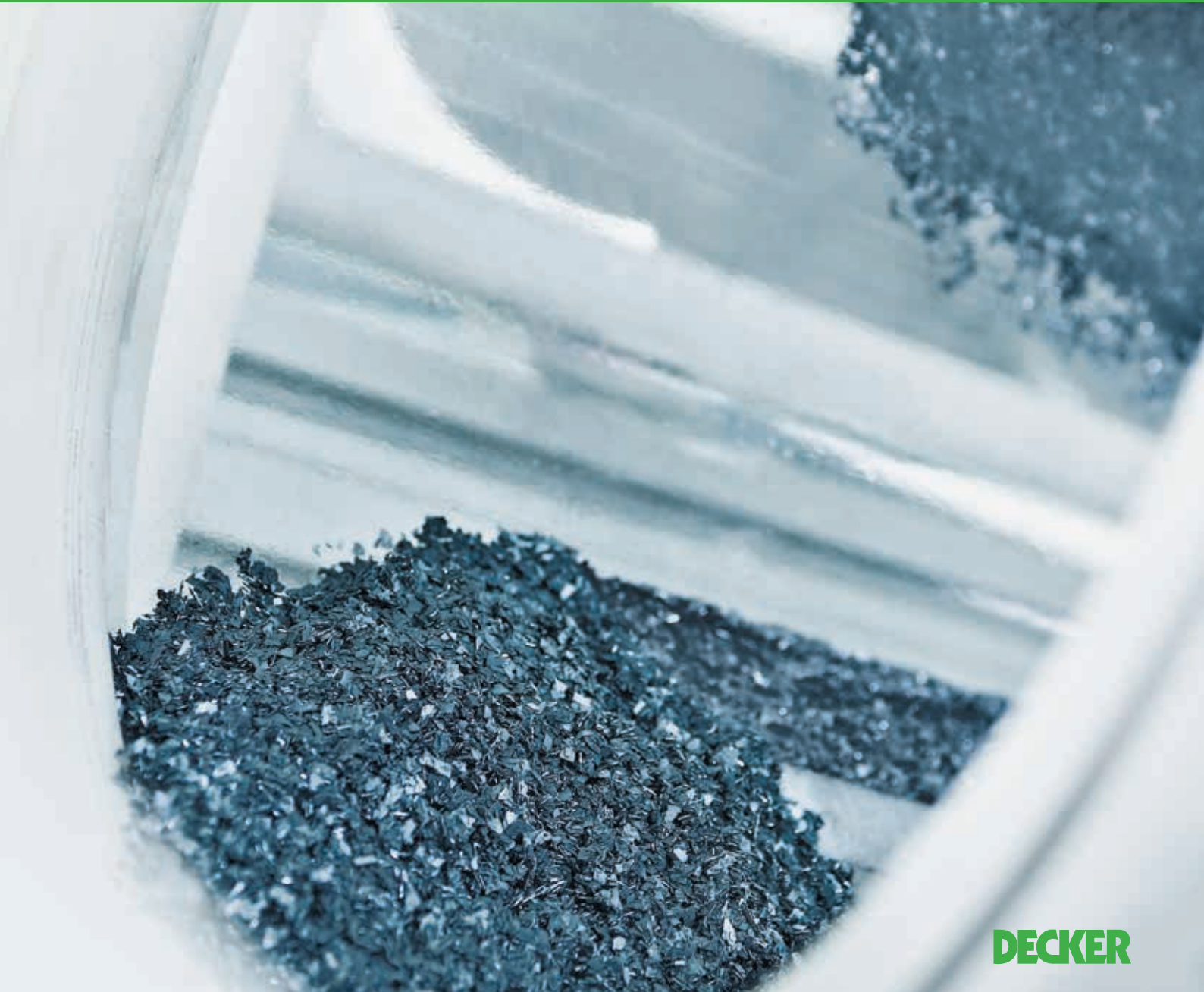


# Granule Etching



**DECKER**



Headquarters of DECKER Anlagenbau GmbH

## About Us

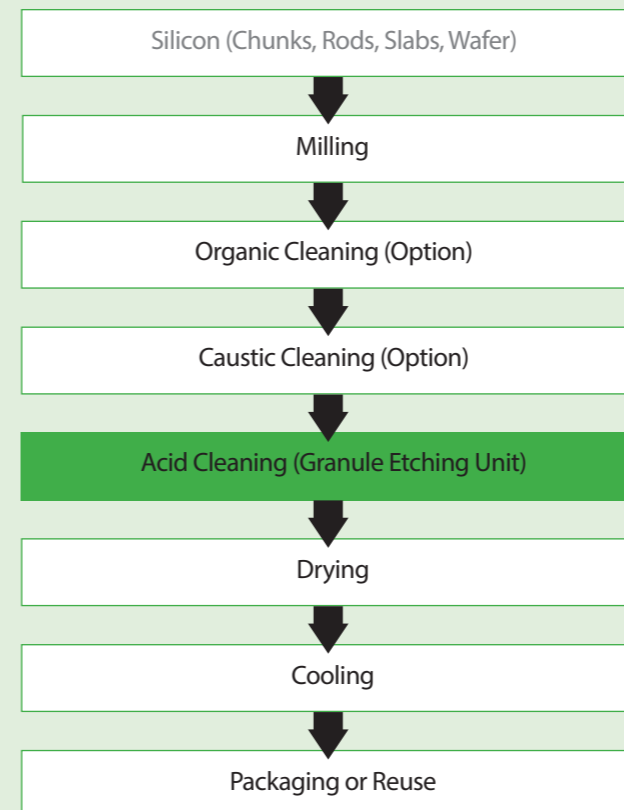
DECKER develops and manufactures leading-edge equipment that provides advanced methods for wet processing of silicon materials like ingots, chunks, granules and slim rods.

Our profound knowledge of cleaning, etching, drying, recycling, handling and waste gas treatment is appreciated by customers in the semiconductor and PV industries. A new member of our product portfolio, the Granule Etching line, is a truly innovative tool that solves the

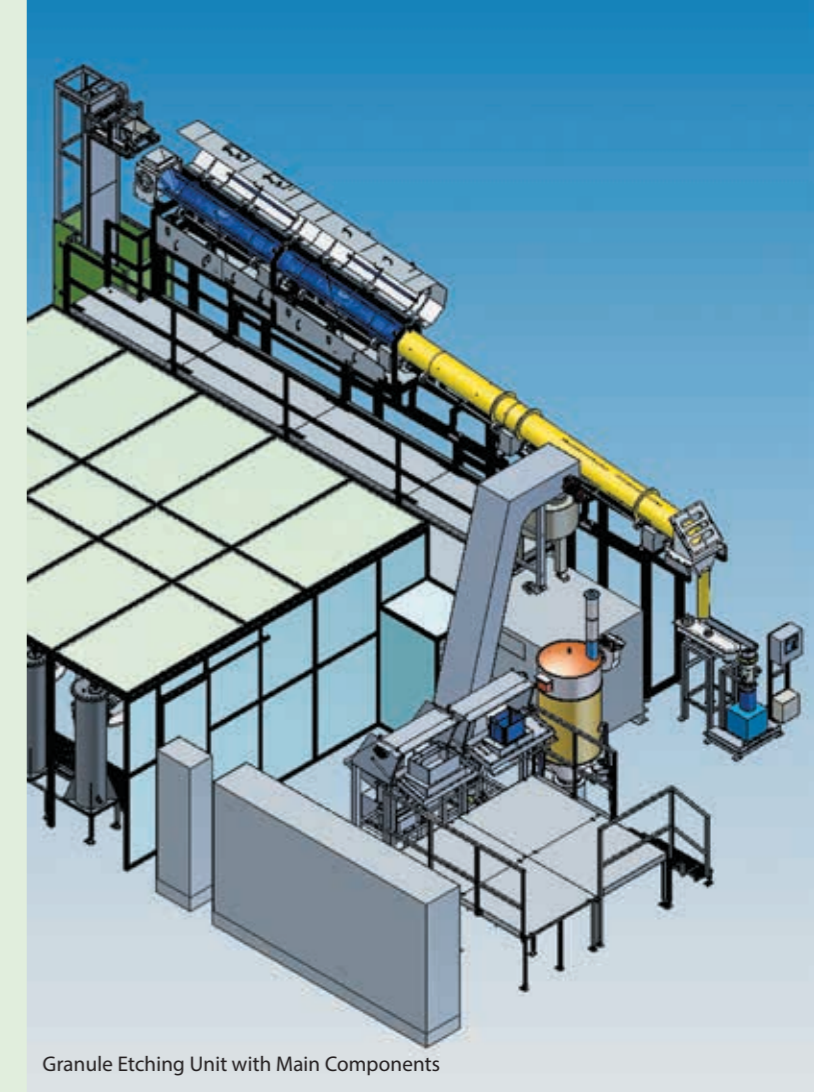
problem cleaning silicon even if it is very small particles. Our specific, tailor-made solutions are often developed in close cooperation with our customers and have been met with a high degree of acceptance.

DECKER is certified to ISO 9001, accredited according to § 19 I Water Management Act and has met the strict quality requirements of the semiconductor and automotive industries for years. DECKER's headquarters is located in southern Germany near Nuremberg.

### Main Process Steps of a Granule Etching Line



On request DECKER will deliver one turn key solution from milling to packaging including waste gas treatment.

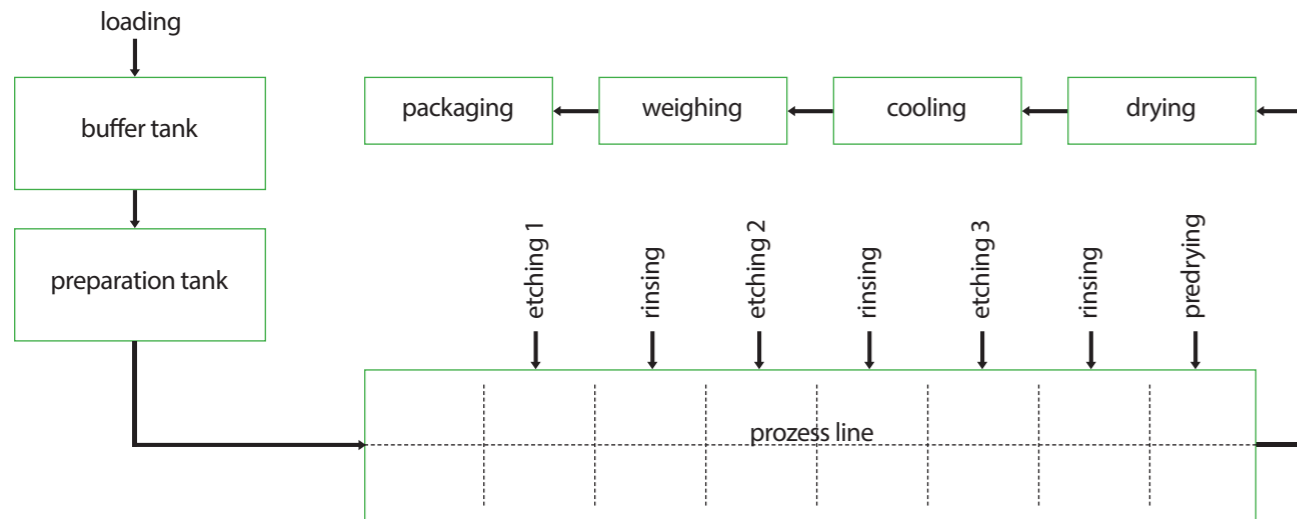


Granule Etching Unit with Main Components

## Granule Etching

The greatest challenge in etching silicon is presented by small particles or granules. Decker's solution to this problem is a sophisticated granule etching tool, which allows small sized silicon debris (> 0.1 mm), granule for feeding and wafer scrap to be cleaned. Due to that recycling option companies have the opportunity of saving literally tons of silicon and more importantly, tons of money. Referring to the production of high quality feeding material DECKER offers an approved tool to remove all impurities from the silicon granule surface. Decker uses acidic etch solutions to achieve superior cleaning results.

Acidic etching (as opposed to alkaline etching) leads to much cleaner surfaces. The equipment is designed as a complete solution, so customers need not worry about how to handle the chemicals. Mixing tanks, effluent tanks and waste gas treatment solutions (for NOx, acids like HF and DI water) are part of the equipment and comply with the most stringent safety requirements. The wet benches are modular and can be tailored to meet the customer's requirements. Leading edge technology by DECKER will decrease your production cost per kilogramm silicon to perform in an even more competitive environment.



## Main Characteristics

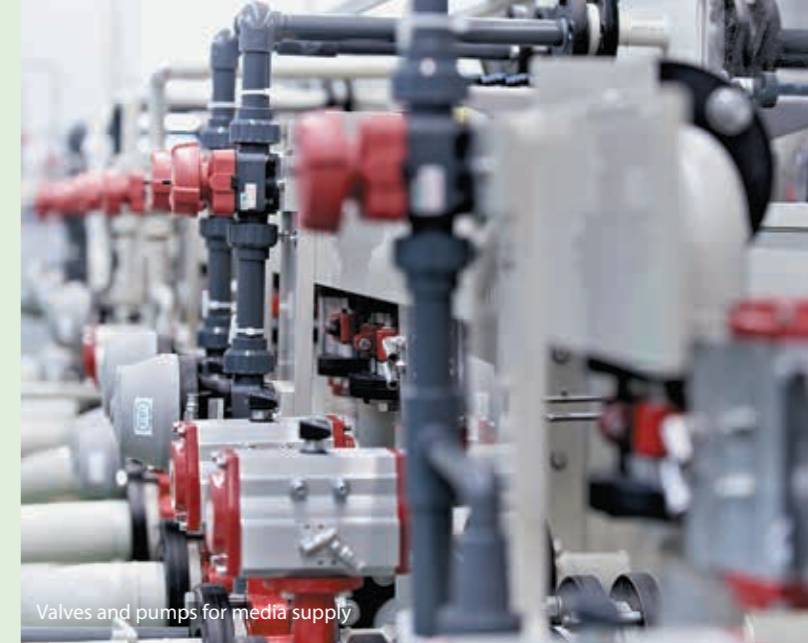
- Highest surface quality level for granule 500 µm to 5 mm
- Reliable product quality due to customer specification
- Tungsten impurities can be removed by DECKER
- Reproducible etch results – Inline monitoring of process parameters
- Minimized DI-water consumption – cascaded water rinsing
- System tested before shipment
- Proven process and machine design
- Rigid, chemical resistant construction - Long term customer satisfaction
- Ease of installation, assembly and future modification – Bench separated in sections with individual modules
- Modest costs – recovery of raw silicon material with low demand for manpower, chemicals and consumables
- For Si - Recycling:
  - Dramatic reduction of costly silicon waste - Reprocessing of nearly all silicon waste and scrap
  - Clean production and almost no loss of silicon material, even when powder is processed – completely enclosed system with integrated exhaust and particle filters
  - Only one system for a great variety of different shapes – No change or adjustment of system necessary

## Operational Advantages

- Highest surface quality
- Lowest TCO
- Reduces labor cost
- Recycling of silicon like wafer scrap
- Leads to better utilization of the silicon production plant
- Connects to the factory MES for statistical analysis, product genealogy and workflow optimization

## Key Benefits

- Profitable – shortest return of invest
- Effective – recycling capacity up to 700 metric tons of granule per year
- Economical - low chemical and rinse water consumption by spray and vacuum supported process
- Reliable - rigid, chemical resistant design for long term customer satisfaction
- Consistent – relevant process parameters are monitored continuously



Valves and pumps for media supply

## Field of Application

### Objective

- Removal of metallic contaminations from the silicon surface
- Clean Drying
- Option: Weight defined packaging of processed product into bags

### Conditioning process

- Multi-stage wet-chemical process with different acids
- Rinsing with water
- Hot drying and cooling

### Transport

- Batch wise cycled flow

### Suitable material

- Raw material: Dry granule silicon
- Processed product: Dry granular or powder silicon, fractioned by sieving
- Final product grain-size: 100 µ - 5mm

### Throughput

- Throughput: 110 kg/hour
- 6.600 working hours/year
- 727 tons per year



Vacuum pump



Granule Etching Line with loading and cooling



Cleaning of Silicon



Media Supply

## Major System Components

- Semiautomatic loading station
- Automated Milling
- Crusher to resize larger chunks pieces
- Etchant preparation, holding tanks and chemical distribution systems
- Pre-drying by vacuum
- Wet chemical processing with conveyor belt for transport and cleaning
- Final drying with electrical infrared heater system
- Cooling
- Option: Automatic bagging and weighing
- Protection against dust and chemicals

## The Goal

Silicon granule with a high surface purity is requested by the market. Due to the increasing quality requirements the surface quality of silicon granule must be excellent. Silicon material in different forms (powder, granular, chunks, wafers etc.) is produced as waste or scrap in different stages of the complete production process of solar wafers. This valuable „scrap material“ can be re-used in the production of silicon ingots, which reduces the cost of manufacturing.

This system enables producers as well as users of solar silicon to clean and recycle this valuable raw-material out of the different stages of the fabrication process and to clean crushed chunks before selling as granule.

Users of this advanced system save raw material, resources and costs and contribute to an environmentally friendly fabrication of solar cells. This cleaning method for silicon granule ensures a constant high surface quality level.



Drying of Silicon Granule

## Peripheral Equipment

- Preparation and supply of process media
- Preparation and supply of Silicon raw material
- Collection and recirculation of process media
- Vacuum generation for filtration and dewatering
- Exhaustion of process line
- Dust collection
- Supply, storage and disposal of chemicals
- Protection against chemicals

# DECKER

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