

## Blending NextSi™ Granular Polysilicon and Siemens Chunk to increase the efficiency of PV ingot manufacturing

REC Silicon has commercialized Fluidized Bed Reactor (FBR) technology to produce granular polysilicon on a wide-scale basis, and is now the world’s largest producer of this kind of polysilicon, which is marketed as NextSi™. FBR technology offers significant benefits to the end-user that enable increased throughput, decreased cost and increased profit in the PV ingot manufacturing process.

The word “granular” is a reference to the size and geometry of the polysilicon material (Figure 1). This form factor offers several advantages over traditional Siemens chunk polysilicon as illustrated in Table 1.

- **Increased Crucible Polysilicon Charge Weight**
- **Reduced Crucible Load Time**



Figure 1. Siemens Chunk and NextSi™ Granular Polysilicon

<b>Process Efficiency</b>	NextSi™ granular polysilicon enhances the efficiency of the PV ingot manufacturing process by increasing the amount of yieldable ingot that can be harvested during a production cycle thereby increasing throughput, reducing production cost and increasing profit.
<b>Bulk Packaging</b>	NextSi™ is packaged in 1,200 kg Flexible Intermediate Bulk Containers (FIBCs). FIBCs require less handling and are easier to unpack than traditional packages thereby reducing handling costs. FIBCs produce less waste than traditional packages.
<b>Automation Potential</b>	Granular polysilicon is a flowable material. End-users can take advantage of process automation opportunities such as automated material transport, crucible loading, top-off and recharge.

Table 1. Benefits of REC Silicon NextSi™ Granular Polysilicon

### Quantified Benefits of Blending Chunk and NextSi™

PV ingot manufacturers can increase initial crucible load weights by as much as 29.3% while reducing loading time by 41.0%. Furthermore, the use of NextSi™ granular at the plant scale can increase the total yieldable ingot produced per year by several hundred tons while reducing consumables cost by several million dollars and providing other benefits.

### Increase the Initial Crucible Load Weight

A known benefit of FBR granular polysilicon is its ability to increase the amount of yieldable ingot that can be harvested during a production cycle. This benefit is realized during the initial filling of the crucible by significantly increasing the crucible charge weight prior to melting. Greater efficiency gains can be achieved by employing techniques such as top-off, i.e. adding polysilicon to the crucible after the initial melt to raise the molten silicon level towards the top of the crucible; and recharge, i.e. replenishing the melt as the ingot is pulled.

Blend	Time to Fill	Improvement vs. 100% Siemens	Improvement vs. 100% Siemens	Weight	Improvement vs. 100% Siemens	Improvement vs. 100% Siemens	Filled Crucible Illustration
100% Siemens	48.4 min	NA	NA	63.8 kg	NA	NA	
100% Granular	2.3 min	46.1 min	<b>95.3%</b>	66.4 kg	2.6 kg	<b>4.0%</b>	
50% Siemens 50% Granular	28.6 min	19.9 min	<b>41.0%</b>	82.5 kg	18.7 kg	<b>29.3%</b>	

**Table 2. Summary of Crucible Loading Test Results**

Note: The results in this table are based on the crucible being filled to the top level with the crucible lip.

### Crucible Loading Test Results Summary

The crucible loading test confirmed that during the initial crucible loading stage the use of a 50% Siemens chunk/50% NextSi™ granular blend increased crucible charge weight by 29.3% and reduced crucible loading time by 41.0% compared to a 100% Siemens chunk blend.

A summary of the test results is illustrated in Table 2.

### Conclusion

The results of a crucible loading test conducted by REC Silicon demonstrates that the use of a 50% Siemens chunk/50% NextSi™ granular blend increases initial crucible charge weight by 29.3% while reducing loading time by 41.0% when compared to a 100% Siemens chunk blend. A model was described which demonstrates that the use of a 50% Siemens chunk/50% NextSi™ Granular blend at the plant scale will result in an increase of yieldable ingot of several hundred tons per year, while reducing consumables cost by several million dollars and providing additional benefits when compared to a 100% Siemens chunk blend. Significant additional benefit can be gained by using NextSi™ Granular for crucible top-off and recharge.

### White Paper

An in-depth technical white paper on this subject is available. Please contact your REC Silicon representative.

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REC Silicon is a leading producer of advanced silicon materials, delivering high-purity polysilicon and silane gas to the solar and electronics industries worldwide. High-purity Signature Silane® gas (SiH<sub>4</sub>) is central to the quality and consistency of all the company's materials. The company combines 25 years' experience and proprietary technology with the needs of its customers to provide value-added raw materials which are used to manufacture solar modules and silicon wafers. REC Silicon is the world's largest silane gas producer and one of the world's largest polysilicon manufacturers, with a capacity of more than 20,000 MT of polysilicon and 29,000 MT of silane gas annually from two US-based manufacturing plants. Listed on the Oslo Stock Exchange (ticker: REC), the company is headquartered in Moses Lake, Washington and employs 800 people.

To learn more, see [www.recsilicon.com](http://www.recsilicon.com)

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