

Minimizing Contamination in Titanium Atomization

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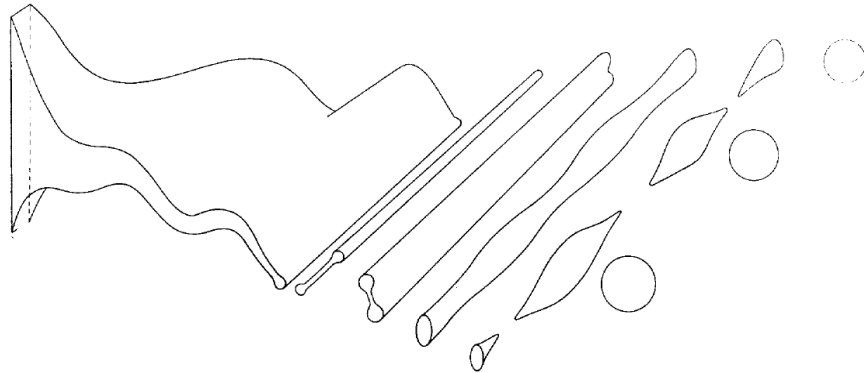
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Summit Materials Plant Overview

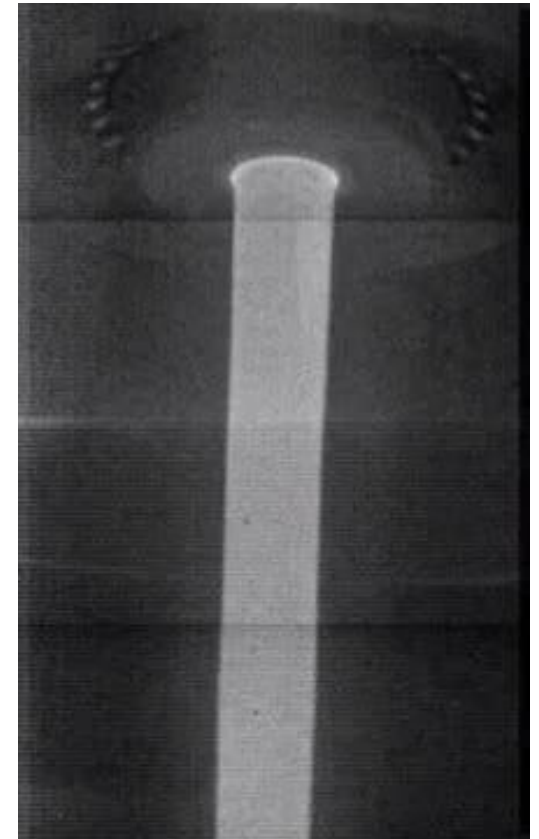
Newly refurbished 55,000 square foot state-of-the-art facility.
Powder Production: Gas Atomizer and Plasma Arc Melter



Gas Atomization: Flowing molten Titanium through a high pressure inert gas (argon) in order to break apart the molten stream into droplets that solidify in-flight into fully alloyed spherical powder particles.

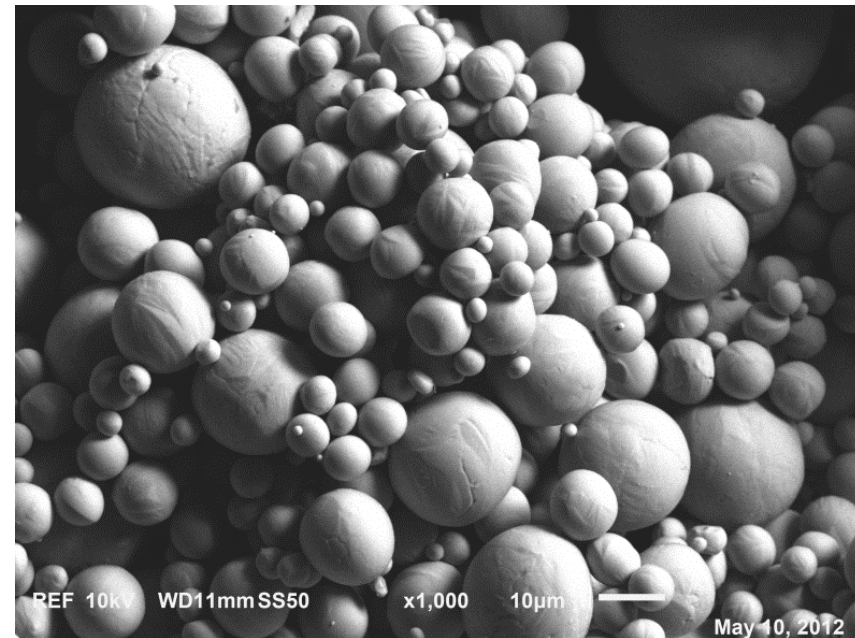


Idealization of Sheet Breakup



Video from Dr. Iver Anderson, AMES Lab.

- Spherical particles
- Free flowing
- High packing density
- Wide particle size distribution
- Chemically pure
- Chemically homogenous
- Chemistry control
- Large capacity



Contamination is a major concern across all Titanium powder manufacturing processes.

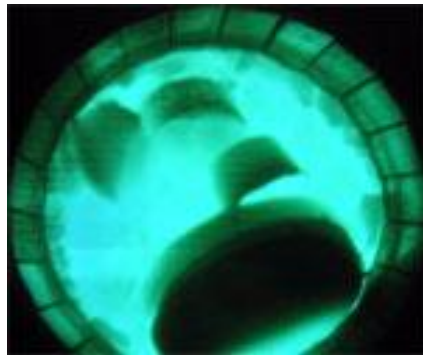
Purpose of this talk: Identify and minimize contamination risks.

- Refractory used in system
- Iron pickup from atomizer components
- Improper / Inadequate cleaning procedures
- Contaminated raw materials

Problem

Refractory used in most systems

- Crucible*
- Nozzle



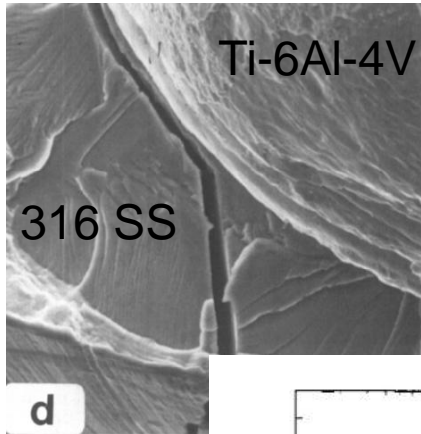
ELIMINATE the refractory

Solution

*Pictures used with permission from PSI Ltd.

Problem

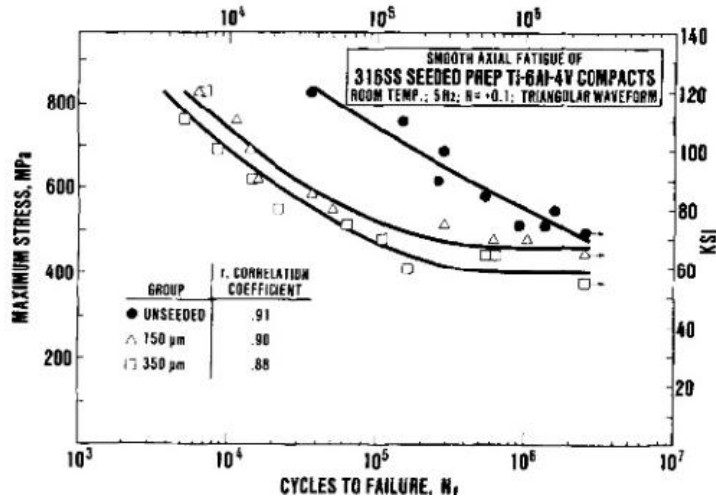
Atomizers are constructed of Stainless Steel. Hot powder impinging steel walls, cones, and piping strips off small amounts of steel that bonds to and contaminates powder.



Ti-6Al-4V (1986 Schwenker)

316 SS

d



Solution

ELIMINATE steel components



All-Titanium tower, cone, piping, cyclone, and collection containers.

Problem

Alloy cross contamination occurs when cleaning between alloys is not done adequately.

Solution

Standard Operating Procedures



Problem

Incoming raw material is out of spec.

- Accepting outside specs:
 - Frequency of testing
 - Testing methods
 - Equipment calibration
 - Testing location

Solution

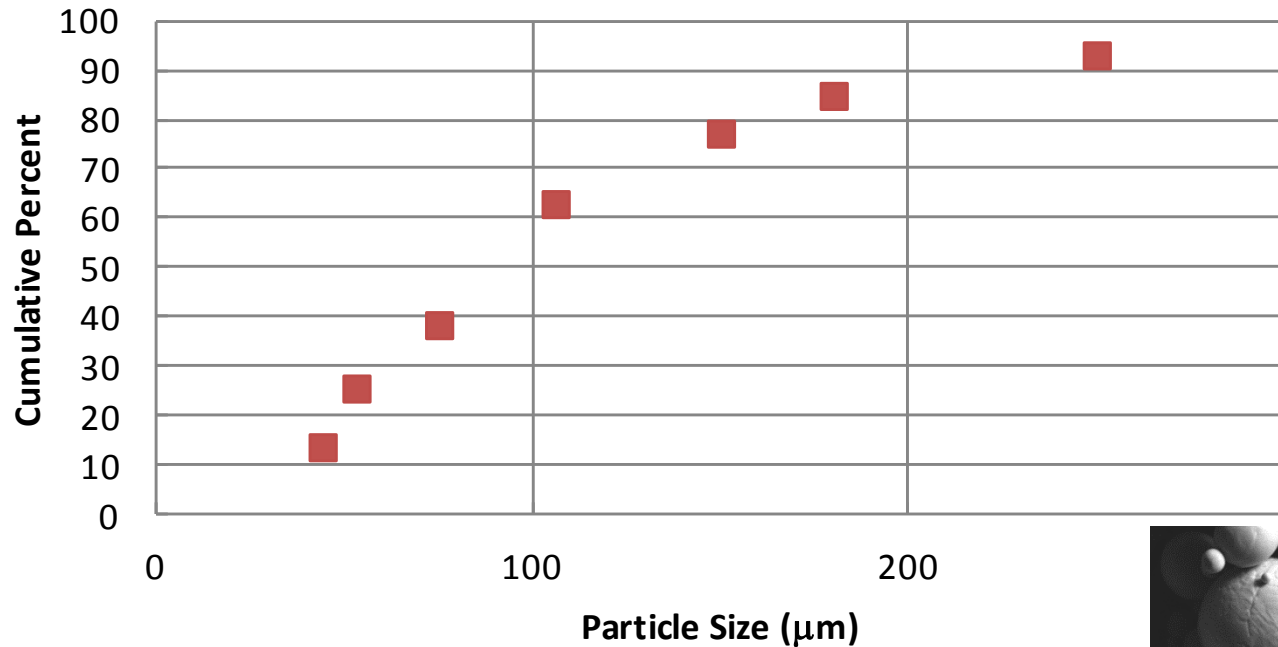
- (1) Produce RM in-house
- (2) System to verify outside material



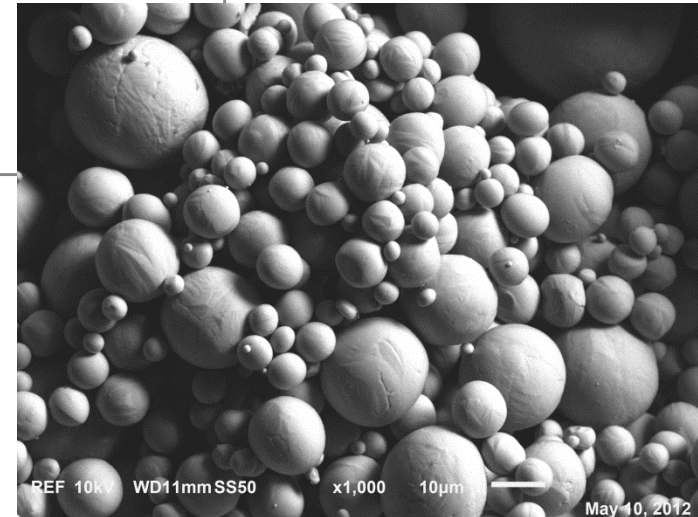
Plasma Arc Melter

- Refractory used in system
- Iron pickup from atomizer components
- Improper / Inadequate cleaning procedures
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Ti-6Al-4V Particle Size Distribution



Tap Density: 2.78 g/cc
Flow Rate: 30 sec.



Typical Ti-6Al-4V Powder Data; Typical Chemistry

Invoice number: 77315
Customer Purchase Order no.: 14-032

Date received: 02/07/14
Report date: 02/14/14
Invoice date: 02/14/14

Description: Six Titanium 6Al-4V samples were analyzed as listed below.

Results:

<u>Sample Identification:</u>	<u>Mesh</u>	<u>Oxygen</u>
		<u>%</u>
EL076	-325	.118
EL076	-35/+100	.081
EL076	-100/+325	.085
EL074 EE1283	-35/+100	.072
EL074 EE1283	-100/+325	.075
EL074 EE1283	-325	.065

Method: Inert gas fusion - ASTM E 1409-13

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