NEW TECHNOLOGY
from
NEW TITANIUM PRODUCER

Oleg Mityashkin
Wire based Additive manufacturing

- AM is on the verge of widespread adoption for full-scale production purposes
- AM allows to decrease the “buy to fly” ratio down to 2.5 from around 10-12 of the standard production (large reduction in waste)\(^1,^2\)
- Reduces the production time 10 times \(^1,^2\)
- AM market will be worth $776.8 Million by 2020\(^3\)

\(^1\) Norsk Titanium [https://www.norsktitanium.com](https://www.norsktitanium.com);  
\(^2\) Cranfield University [www.waammat.com](http://www.waammat.com) (picture taken)  
\(^3\) 3D Printing Metal Market
Titanium wire for Additive Manufacturing

Forecast of the world Titanium Wire consumption, tons\(^1\)

\(\begin{array}{cccccccc}
1800 & 2400 & 3100 & 4000 & 4800 & 6100 & 7500 & 9300 \\
\end{array}\)

\(^1\)Forecast made by Hermith GmbH based on data from the largest consumers of the titanium additive wire

\(^2\)Picture taken from [https://www.norsktitanium.com](https://www.norsktitanium.com)
“Warm” wire drawing

- New technology was developed
“Warm” wire drawing

- New technology was developed
- Received 17 Patents
Technology process

- the wire is heated up during the drawing process
- the material is more ductile \(\Rightarrow\) increase in the rate of the deformation
- do no need to anneal the wire between the stages
- strict control of the optimal temperature and speed is required
  - control with acoustic emission
Acoustic emission control

- Acoustic sensor is mounted in the area of the drawing die
- The deformation process of the wire is accompanied by the acoustic waves radiation
- The energy parameter of the waves allows to identify the process of microcracks forming
- Experimentally, the value of energy parameter was established, when the deformation occurred without the formation of microcracks
- Optimal temperature and speed were obtained
Comparison to the cold drawing

“Warm” drawing production time – up to 4 days for 1000 kg

<table>
<thead>
<tr>
<th>Pass number</th>
<th>Operation</th>
<th>Input Diameter, mm</th>
<th>Output Diameter, mm</th>
<th>Speed, m/min</th>
<th>Length per 1 ton, m</th>
<th>Time to produce 1 t, hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drawing</td>
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<td>15,35</td>
</tr>
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</table>

Total 83,8 (3,5 days)
## Cold drawing production time – up to 70 days for 1000 kg

<table>
<thead>
<tr>
<th>Pass number</th>
<th>Operation</th>
<th>Input Diameter, mm</th>
<th>Output Diameter, mm</th>
<th>Speed, m/min</th>
<th>Length per 1 ton, m</th>
<th>Time to produce 1 t, hours</th>
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</thead>
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<td><strong>Total</strong></td>
<td><strong>1675 (70 days)</strong></td>
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<td><strong>Drawing time</strong></td>
<td><strong>240 (10 days)</strong></td>
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**Comparison to the cold drawing**

Cold drawing production time – up to 70 days for 1000 kg
## Advantages of the warm drawing

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<thead>
<tr>
<th></th>
<th>COLD DEFORMATION</th>
<th>WARM DEFORMATION</th>
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</thead>
<tbody>
<tr>
<td><strong>Degree of deformation per one stage</strong></td>
<td>low (10-15%)</td>
<td>high (35-45%)</td>
</tr>
<tr>
<td><strong>The number of production stages</strong></td>
<td>large (≥45)</td>
<td>reduced (≤8)</td>
</tr>
<tr>
<td><strong>Heat treatments</strong></td>
<td>after each stage</td>
<td>no</td>
</tr>
<tr>
<td><strong>Energy consumption</strong></td>
<td>high level</td>
<td>mid-level</td>
</tr>
<tr>
<td><strong>Time of production</strong></td>
<td>Long (up to 70 days for 1 ton)</td>
<td>Short (less than 4 days for 1 ton)</td>
</tr>
<tr>
<td><strong>Production costs</strong></td>
<td>High</td>
<td>Low</td>
</tr>
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</table>
Ongoing projects
Ongoing projects

- Material Development for suspension Springs

- 2 new titanium alloys – HSA, HSA2
Ongoing projects

- Material Development for suspension springs

✓ 2 new titanium alloys: HSA, HSA2

TEST CERTIFICATE

CLIENT: HERMITH GMBH
Englmannstr. 2
81673 Munich
Germany

CONTACT: Inh. Herbert Weiss

SAMPLE IDENTIFICATION:
2 no. 1 long open-ended springs, manufactured from Hermich Spring Alloys 2 “HSA2” is an alpha-beta alloy with enhanced mechanical properties

ORDER RECEIVED DATE:
1st November 2017

TEST COMPLETION DATE:
21st December 2017

TEST PROCEDURE:
Fatigue test to client’s requirements in conjunction with OI 26 issue 7. Load test to documented in-house methods OI 26 issue 10

Fatigue testing 2 off compression springs identified as open-ended long titanium springs.

Each spring had pre-noted load requirements for fatigue testing. Each spring was load tested to its minimum and maximum working loads, and working lengths were found from the results. Springs were tested at ambient temperature and a test speed of 300 cycles per minute.

<table>
<thead>
<tr>
<th>Spring No.</th>
<th>Cycles Completed</th>
<th>Broken</th>
<th>Unbroken</th>
<th>Length (mm) at Load (N)</th>
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<td>500,000</td>
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</table>
Ongoing projects

- Material Development for Sonotrodes

☑ 2 new titanium alloys – HSS, HSS2
2004
Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2
Our Past and Present

2004
Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2

2007
Cooperation with leading titanium producers and project kickoff with car OEMs
Our Past and Present

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Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2

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Cooperation with leading titanium producers and project kickoff with car OEMs

2011
Ongoing projects with Aerospace OEMs & tier suppliers
Stocking and distribution of 100+ tonnes per year of VSMPO materials

2015
Established strategic cooperation with titanium parts supplier for the development of new titanium materials, specifically spring wire and sonotrode alloy
Our Past and Present

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Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2

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2016
First design and engineering work on development of technology for drawing titanium wire for Additive manufacturing

2016
Beginning Cooperation with Russian based mill for the development and production of titanium products with support of the Bavarian and Russian Governments
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Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2

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2017
Hermith certified as EN9100 for Munich and Russian production Campus
First deliveries to European aerospace market
Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2

Ongoing projects with Aerospace OEMs & tier suppliers
Stocking and distribution of 100+ tonnes of VSMPO materials

Established strategic cooperation with titanium parts supplier for the development of new titanium materials, specifically spring wire and ultrasonic alloy

Hermith certified a second Russian production Campus
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2004

2019
Hermith and TVEL Fuel Company of ROSATOM have concluded an agreement on joint production of the titanium final products, such as aircraft tubular assemblies, automobile suspension components, implants and prostheses for medicine, sonotrodes and promotion of these products to the European and other prominent markets.
Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2

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2019-2022

Cooperation extension - increasing number of production Campuses and raw material suppliers
Our Customers

Over 2000 customers in Europe and rest of the world
Customer geography covers more than 20 countries

Our main markets

Aerospace
Automotive
Defense
Medical

Our customers overview

89% Producers
11% Distributors
Production Facilities of Hermith

Organised and established Hermith production campuses on the basis of Joint Ventures with Russia based Ti producers

All melting of ingots and production of the products done within the Hermith production facilities

Hermith Production facilities certified under EN9100
Titanium ingots production

Raw materials for melting are titanium sponge and master-alloys.

Pressed briquettes Ø200…360 mm for furnace electrodes.

VAR ingots Ø360…450 mm after double or triple melting.

VAR ingots Ø280…360 mm for mold casting.
Titanium billets production

Hot forging machines

Hot rolled mills
Hot extrusion and hot worked stage

The billets of bars and tubes are extruded at various equipment as horizontal and vertical presses.
Hot & cold forging. Heat treatment

Radial forging machines
Tubes Ø30…130 mm
Rods Ø23…130 mm

Horizontal and vertical vacuum furnaces
Rolling and final operations

Rolling mills (Ø18 – 250 mm)

Cold pilgering mills (Ø6-120 mm)

Grinding (Ø6…150 mm)
Drawing Equipment

Linear and coil to coil drawing

Gas shielded bypass annealing
Final quality control

Non-destructive ultrasonic and eddy current inspection of final rods and tubes.

Gas Analyzer for infra-red absorption measurements. Definition range is from 0.001 to 2.0%.

Research equipment for digital investigation of metal structure.

Plasma mass spectrometer. Range is from $1 \cdot 10^{-5}$ to $1 \cdot 10^{3}$ weight %.

X-ray Fluorescence Analyzer.
Products

Ingot  Plate  Bar  Tube  Wire

Alloys
Grade 2, 4, 5, 7, 9, 6242, 6246, 6Al 7Nb, 7Al4Mo, HSA, HSS, ПТ-1М, ПТ-7М, ПТ-3В, 3М, BT1-0, BT1-00, 2B, BT6, BT-6C, BT9, BT3-1, сп19, BT-16
Thank you for your attention