Fighting wear, corrosion, galling and fatigue on stainless steel and titanium alloys
Agenda

- **Expanite®**: Who we are
- **Expanite® Processes**: How we do it
- **Wear and Corrosion** after... Testing Expanite®
- **Expanite®** in **various Industries**
From research to business

• Expanite® founded in 2010
  ...but development goes back to 2000!

• First major customer early 2012

• Company culture driven by being a game-changer on the following parameters
  • Speed -> Costs
  • Tailoring
  • Cleanliness

• Expanite® today
  • Approx. 30 employees
  • Treatment centers in Denmark, Germany, USA, China & Korea
Expanite® Processes:
How we do it
What is Expanite®?

A technology
- process/recipe
- time + temperature + pressure + gas flow + surface physics & chemistry in a furnace
- a gas-based diffusion process
Product portfolio

• Tailoring of four core processes
  • ExpaniteHigh-T
  • ExpaniteLow-T
  • SuperExpanite® = ExpaniteHigh-T + ExpaniteLow-T
  • ExpaniteHard-Ti

• Other services include
  • Material recommendation/selection
  • Implementation & quality control of Expanite

Patent families:
SuperExpanite® WO2012146254
ExpaniteLow-T WO2011009463
The processes

**ALLOY**

**AUSTENITIC**

**PROCESS**

- **SuperExpanite**
  - ExpaniteHigh-T

**DUPLEX**

**FERRITIC**

**MARTENSITIC**

**ExpaniteHigh-T**

A high-temperature solution-nitriding process pushing nitrogen deep into the bulk material. This re-establishes the core hardness of the material, which creates a unique load-bearing capacity and secures corrosion resistance second-to-none.

**Benefit:**
Get all the best things of annealing while maintaining core hardness and increasing corrosion resistance.

Temperature in vacuum: 1000-1200°C
Fast gas quench
Adds nitrogen
DK: 400 x 400 x 600 mm
DE: 400 x 400 x 1000 mm
**Expanite High-T process – martensitic example**

**AISI 410 / 1.4006**

12.5Cr-0.12C-(1.5Mn+1.0Si max)

Treatment: Expanite High-T

Case Depth High-T: 0.55 mm

Surface hardness: 750 HV0.3
The processes

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**ExpaniteLow-T**

A low-temperature nitrocarburizing process, by which a double hardened zone containing nitrogen and carbon is established. Nitrogen adds increased surface hardness while carbon bridges the gap to the softer core. A smooth hardness profile is tailored!

**Benefit:**

Controlled surface hardness between 1000-1500HV.

Temperature in atmospheric environment:
380 – 470°C

Adds nitrogen and carbon in solid solution

DK: 600 x 600 x 1.000 mm
DE: 400 x 400 x 1.000 mm
The Expanite Low-T process

Too high temperature – corrosion resistance lost!

Low temperature – supersaturated solid solution
The Expanite \textbf{Low-T} process, schematically

- \textbf{N + C} or \textbf{C only}
- Up to 35-40µm
- Up to 1500HV
# The processes

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* including precipitation-hardenable steels

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## SuperExpandite

By combining the ExpanditeHigh-T and ExpanditeLow-T processes you get a previously unseen surface hardness founded on top of a bulk material, which has very strong loadbearing capacity. Superior corrosion, wear and fatigue properties is the outcome – SuperExpandite is simply setting new standards for what can be achieved by surface-hardening stainless steel.

**Benefit:**
Superior corrosion, wear, scratch and fatigue properties.
Expanite Hard-Ti

- Temperatures in vacuum: < 800°C
- Diffusion process without titanium nitrides
- Application possibilities:
  - Alloyed titanium e.g. Grade 5
  - Pure titanium e.g. Grade 2
- Surface hardness: ca. 1.000 HV
- Case depth: 10-50µm
Wear and Corrosion after......

Testing Expanite
Improved wear resistance

- Duplex 2205
- Knifes used to cut enzyme powder
- Accelerated wear without Expanite® hardening

Unused knife

Used knife without Expanite

Used knife with Expanite
What’s unique -> 125x wear resistance

ASTM G133 wear test on AISI316

Conclusion: 125 times less wear on SuperExpanite treated plane surface
What’s unique -> new standards in galling resistance

ASTM G98 galling test on AISI316

Untreated vs. untreated  SuperExpanite vs. SuperExpanite

Above yield strength!

Owner of Bud Labs: “..has never seen anything perform so well on 316 in his 15 years of tribology testing”
Improved corrosion resistance

Pitting potential increase: 400 mV

EN 1.4401 (AISI 316)
Pitting resistance in seawater
Expanite Treatment in Various Industries
Expanite Treatment in Various Industries

- OIL & GAS
- AUTOMOTIVE
- MEDICAL
- INDUSTRIAL
- PUMPS & VALVES
- CONSUMER GOODS
- MARINE
- FOOD & BEVERAGE
Typical parts
Summary - What Expanite® can be used for...

- Generally increase wear, galling or corrosion resistance of stainless steel and titanium!
- More specifically for austenitic and duplex stainless steel:
  - Replace known processes such as Kolsterising® from Bodycote. Typically outcome; faster lead-time, cost reduction and improved corrosion resistance.
  - Replace hard-chrome plating/coatings. Typically outcome; replace the coatings with diffusion -> no issues with spalling & in-homogenous layers, better environmental compliance.
  - Replace plasma nitriding. Typically outcome; improved corrosion resistance.
- More specifically for ferritic and martensitic stainless steel:
  - Replace conventional heat treatment / vacuum hardening. Typically outcome; significant increase in wear and corrosion resistance.
Goes beyond the surface to reduce lead time and costs

**THE BEST PRODUCT**
- The best in wear and corrosion resistance when it comes to surface hardening of stainless steel
- No matter choice of stainless steel, there is a solution

**SHORTEST LEAD TIMES**
- Processes are running day-to-day
- 2-3 working days lead time is offered
- Standard lead time 6-9 working days

**TAILORED & STANDARD**
- Hardening processes can be tailored matching individual requirements
- The product portfolio includes a wide-range of standard solutions

**“YOUR PLACE OR MINE?”**
- Treatment centers in Denmark, Germany and the US
- The possibility to install equipment on-site with customers
- Production sites are ISO9001 certified and CO19 compliant

**TOTAL COST OPTIMISATION**
- The best product gives the longest lifetime
- The shortest lead times reduces inventory and work in progress
- Competitive pricing completes the cost optimization

**OPENNESS AND PARTNERING**
- Considering the needs of the end user
- Understanding your process and challenges
- Focusing on knowledge sharing
What’s next?

• Upcoming webinars
  • June 12, 8.30 am & 11 am: Fresh, tasty and well packaged
  • Next round of webinars already in planning, i.e. watch your mailbox and follow us on LinkedIn

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