Warm forming Lubricant — we set a new standard

Dubai, January, 2013
Steffen Bugner, Chemische Fabrik Budenheim
Budenheim – looking back

- Established in 1908 for the purpose of producing tartaric acid salts from tartar

- After the first World War focus on the development and expansion of phosphates production

- This forward-looking philosophy was important for the establishment of today’s international significance of Budenheim

- The collaboration with the Dr. Oetker Group in Bielefeld, Germany, which exists since 1923, forms the basis for the company’s positive development
... into a global presence
Every year more than 6,000 Customers receive...

- 4.7 Mio. bags
- on 136,000 pallets
- in 3,600 containers
- in 13,000 truckloads
- in 110 countries

(representative numbers of the year 2008)
Budenheim provides a full range of PHOSPHATHERM® hot forming materials. We offer tailor-made solutions for most seamless tube manufacturing process steps. With over 40 years of experience developing high quality products to meet the unique needs of our customers, Budenheim has established itself as an industry leader.

Major product and process application fields are:
1. PHOSPHATHERM® Pre-forming materials
2. PHOSPHATHERM® Descaling lubricating and separating materials
3. PHOSPHATHERM® Mandrel bar lubricants and separating agents
4. PHOSPHATHERM® Post-forming materials + special purposes
PHOSPHATHERM® - lubricate tailor-made!

- Push bench / CPE process
- Pilger process
  - Plug mill process
  - Assel / Diescher mill processes

- Conti mill processes:
  - MPM (Multistand Pipe Mill)
  - PQF process (Premium Quality Finishing)
  - Mandrel mill (FM)

- PSW mill process
- KRM mill process
example: PQF/FQM process

- Depending on the single process steps we recommend the use of PHOSPHATHERM® lubricants as follows
Desoxidation of the inner surface of the hollow

Process step 1

- PHOSPHATHERM® 3950 F in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.

- Also available: PHOSPHATHERM® 3950 C in coarse / granulated form
Process step 2

with graphite containing suspension 30 %

- PHOSPHATHERM® 910, standard lubricant, or
- PHOSPHATHERM® 956 (30 %), especially for rolling alloyed and high alloyed steel grades,
- PHOSPHATHERM® 948/8 (30 %), especially designed for prevention against carburization,
- PHOSPHATHERM® 962 (30 % ready-to-use suspension), especially designed for cold mandrel bars (starting up + after interruptions).
Technical advantages

• Distinct reduction of scale
• Additional lubricating effect

• PHOSPHATHERM® is free of corrosive components
• best inner surface quality

• Low friction
• Improved production of alloyed steel

• Better environmental and hygiene conditions
• Lower rolling forces

• Improvements of the tube quality
Economical advantages

- Less maintenance
- Increased life time of tools
- Lower scrap rate
- Less production interruptions

Summary:
High production efficiency, due to optimizations of process, production cost and production stability
# PHOSPHATHERM®
Standard product range / graphite free

<table>
<thead>
<tr>
<th>liquid product</th>
<th>solid product</th>
<th>USP</th>
<th>used with</th>
<th>concentration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHOSPHATHERM® 901</td>
<td>Multi purpose</td>
<td>Assel, Pilger Mills/Push Benches/Piercing press</td>
<td>powder/solution 5-10/3-5</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® 904</td>
<td>Multi purpose</td>
<td>Push Benches, PSW, Diescher, Pilger Acusoll, Piercing press</td>
<td>powder/suspension 5-12</td>
<td></td>
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<tr>
<td>PHOSPHATHERM® 906</td>
<td>Multi Purpose/low Boron</td>
<td>Push Bench, Assel, Diescher, Pilger Acusoll, Piercing press</td>
<td>powder/suspension 5-12</td>
<td></td>
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<tr>
<td>PHOSPHATHERM® 971</td>
<td>no corrosion</td>
<td>Expander Mills</td>
<td>solution 2-10</td>
<td></td>
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<tr>
<td>PHOSPHATHERM® 3902</td>
<td>white lube/low Boron</td>
<td>Push Benches/CPE/TPE</td>
<td>solution 8-12</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® 3903</td>
<td>white lube/low Boron</td>
<td>Push Benches/CPE/TPE</td>
<td>solution 8-12</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® 3912</td>
<td>Alloy rolling/low Boron</td>
<td>Push Benches/CPE/TPE</td>
<td>powder, fine</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® 3950 F</td>
<td>free flowing/low dosage</td>
<td>Conti Mills (FM, PQF, MPM, FQM)</td>
<td>powder, finer</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® 3950 C</td>
<td>free flowing/low dosage</td>
<td>Conti Mills (FM, PQF, MPM, FQM)</td>
<td>powder, coarse</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® 3953 F</td>
<td>free flowing/low dosage</td>
<td>Conti Mills (FM, PQF, MPM, FQM)</td>
<td>powder, finer</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® 3960 C</td>
<td>free flowing/low dosage</td>
<td>Conti Mills (FM, PQF, MPM, FQM)</td>
<td>powder, coarse</td>
<td></td>
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<tr>
<td>PHOSPHATHERM® 3999</td>
<td>separating/low Boron</td>
<td>Piercing Press</td>
<td>powder/suspension 5-10</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® WHITE 3986</td>
<td>tool smoothing</td>
<td>Tool Benches</td>
<td>solution 5-10</td>
<td></td>
</tr>
<tr>
<td>PHOSPHATHERM® WHITE 3986 BP</td>
<td>tool smoothing/thin walls</td>
<td>Push Benches/CPE/TPE</td>
<td>solution 8-12</td>
<td></td>
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</tbody>
</table>
Lubrication benefits using Phosphates

- Phosphatising creates an effective separating layer
- Reduces the risk of welding
- Natural graphite integrated in separate layer
- High temperature stability of the inorganic Phosphate layer
- Inhibition of corrosion
- Phosphates dissolve scale particles -> additionally lubrication
- Scale protecting melting layer -> less secondary scaling
- Phosphates do not degrade, even at very high temperatures
PHOSPHATHERM®
Standard product range / containing natural graphite

<table>
<thead>
<tr>
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<th>Solid product</th>
<th>USP</th>
<th>Used with</th>
<th>Concentration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHOSPHATHERM® 9102</td>
<td>PHOSPHATHERM® 910</td>
<td>thick layer</td>
<td>Conti Mills (POF, MPW, FQM)</td>
<td>ready/suspension 20</td>
</tr>
<tr>
<td>PHOSPHATHERM® 9112</td>
<td>PHOSPHATHERM® 911</td>
<td>temperature stable</td>
<td>Pellet mills, Conti Mills (FM)</td>
<td>ready/suspension 15-30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Conti Mills - FM</td>
<td>suspension 25-30</td>
</tr>
<tr>
<td>PHOSPHATHERM® 93754</td>
<td>PHOSPHATHERM® 937</td>
<td>temperature stable</td>
<td>Conti Mills - FM</td>
<td>ready/suspension 25-30</td>
</tr>
<tr>
<td>PHOSPHATHERM® 9306</td>
<td>PHOSPHATHERM® 930</td>
<td>temperature stable</td>
<td>Conti Mills - FM/Assel Mills</td>
<td>suspension 15-25</td>
</tr>
<tr>
<td>PHOSPHATHERM® 948</td>
<td>PHOSPHATHERM® 948</td>
<td>high-molten temperature</td>
<td>Puhl punches/CPE</td>
<td>suspension 10-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>low carbonization</td>
<td>Conti Mills/Forg/Multi purpose</td>
<td>ready/suspension 20</td>
</tr>
<tr>
<td>PHOSPHATHERM® 952</td>
<td></td>
<td>new bars</td>
<td>Puhl punches/CPE</td>
<td>dilution 1:2 - 1:2</td>
</tr>
<tr>
<td>PHOSPHATHERM® 9551</td>
<td>PHOSPHATHERM® 955</td>
<td>alloy rolling/no welding</td>
<td>Conti Mills (POF, MPW, FQM)</td>
<td>ready/suspension 20</td>
</tr>
<tr>
<td>PHOSPHATHERM® 962</td>
<td></td>
<td>low fume temperature/freeze drying</td>
<td>Conti Mills (POF, MPW, FQM)</td>
<td>ready to use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>temp stable viscosity/thick layer</td>
<td>Conti Mills (POF, MPW, FQM)</td>
<td>suspension 30</td>
</tr>
<tr>
<td>PHOSPHATHERM® 970</td>
<td></td>
<td>high solid content</td>
<td>Tube forging/Forging Press</td>
<td>dilution 1:2</td>
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<tr>
<td>PHOSPHATHERM® 9752</td>
<td>PHOSPHATHERM® 975</td>
<td>finest graphite</td>
<td>Tube upsetting</td>
<td>dilution 1:5/suspension 10</td>
</tr>
<tr>
<td>PHOSPHATHERM® 39702</td>
<td>PHOSPHATHERM® 3970</td>
<td>low fume temperature/freeze drying/low carbonization</td>
<td>Conti Mills (POF, MPW, FQM)</td>
<td>ready to use</td>
</tr>
</tbody>
</table>
Technical advantages

- Best lubrication effect through parallel layer crystal structure ->
- see TEMicroscope pictures

- Very soft particles
- High content on Carbon – up to 99 %
- Very high specific surface area
- Best lubrication property
Best performance and results are obtained by using PHOSPHATHERM® lubricants for hot forming processes, when preparation and application of these products are used in combination with suitable, efficient and state-of-the-art application equipments.
Customer orientation & service

- Worldwide service & plant trial assistance of Budenheim technicians and sales people
- Provision of service & training in our technical application labs in Budenheim
- Tailor-made products
- Cooperated development with metallurgical institutes, customers and engineering for rolling and forming lines & tools
- Exclusive agencies in all major markets, each with own warehousing system
• Push bench / CPE process
• Pilger process
• Plug mill process
• Assel / Diescher mill processes

• Conti mill processes:
• MPM (Multistand Pipe Mill)
• PQF process (Premium Quality Finishing)
• Mandrel mill (FM)

• PSW mill process
• KRM mill process
Process step 1  
**Lubrication of the piercing process**  
with graphite free PHOSPHATHERM 3999 powder into the die and with graphite suspension PHOSPHATHERM 911 onto the mandrel

Process step 2  
**Desoxidation of the inner surface of the hollow bloom**  
PHOSPHATHERM 3912 in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling. Special separating additives for alloyed steel forming

Process step 3  
**Mandrel bar cooling**  
With Mandrel bar cooling equipment, installation of water supply system and cooling drums results a depression of the mandrel temperature of: $D_t \approx 200 \, ^\circ C$

Process step 4  
**Lubrication of the mandrel bars**  
PHOSPHATHERM 3986, colourless solution. Temperature range (bars): 380-480°C.  
PHOSPHATHERM 3986 BP, colourless solution for thin wall sizes. Temperature range, as above.  
PHOSPHAHERM 952, graphite containing suspension for lubrication of new mandrel bar sets and for additional lubrication of the mandrel head.  
Mandrel bar lubrication while rolling tubes with large dimensions (wall thickness). Without temperature limitation.
Process step 1

**Desoxidation of the inner surface of the hollow**

PHOSPHATHERM 3950 in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.

Process step 2

**Lubrication of the mandrel bars**

with graphite free PHOSPHATHERM 3986 solution 5 – 10 %, standard lubricant, or with glass containing PHOSPHATHERM 3989 powder, injected into the hollow bloom while rolling high alloyed steel.
Process step 1
**Lubrication of the piercing process**
with graphite free PHOSPHATHERM 3999 powder into the die and with graphite suspension PHOSPHATHERM 911 onto the mandrel

Process step 2
**Desoxidation of the inner surface of the hollow**
PHOSPHATHERM 3960 C in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.

Process step 3
**Lubrication of the Pilger mandrels**
with graphite containing suspension 15 % PHOSPHATHERM 911/2, standard lubricant
Process step 1

**Lubrication of the guide shoes**

with approx. 5 - 10% graphite free suspension of PHOSPHATHERM 3954

Process step 2

**Desoxidation of the inner surface of the hollow**

PHOSPHATHERM 3950 in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.

Also available:

PHOSPHATHERM 3950 C in coarse / granulated form

Process step 3

**Lubrication of the mandrel bars**

with graphite free PHOSPHATHERM 904 solution 5 – 10 %, standard lubricant, or alternatively with

with graphite containing PHOSPHATHERM 939 suspension 15 – 20 %
Process step 1

**Desoxidation of the inner surface of the hollow**

PHOSPHATHERM 3950 in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.

Also available:

PHOSPHATHERM 3950 C in coarse / granulated form

Process step 2

**Lubrication of the mandrel bars**

with graphite containing suspension 30 % PHOSPHATHERM 910, standard lubricant, or PHOSPHATHERM 956 (30 %), especially for rolling alloyed and high alloyed steel grades, PHOSPHATHERM 948/8 (30 %), especially designed for prevention against carburization, PHOSPHATHERM 962 (30 % ready-to-use suspension), especially designed for cold mandrel bars (starting up + after interruptions).
Process step 1

**Desoxidation of the inner surface of the hollow**

PHOSPHATHERM 3950 in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.

Process step 2

**Lubrication of the mandrel bars**

with graphite containing suspension 35 % PHOSPHATHERM 910
PHOSPHATHERM -> Mandrel mill (FM)

Process step 1
**Desoxidation of the inner surface of the hollow**
PHOSPHATHERM 3950 in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.
Also available:
PHOSPHATHERM 3950 C in coarse / granulated form

Process step 2
**Lubrication of the mandrel bars**
with graphite containing suspension 30 % PHOSPHATHERM 937, standard lubricant, or PHOSPHATHERM 956 (30 %), especially for rolling alloyed and high alloyed steel grades, PHOSPHATHERM 948/8 (30 %), especially designed for prevention against carburization, PHOSPHATHERM 962 (30 % ready-to-use suspension), especially designed for cold mandrel bars (starting up + after interruptions).
Process step 1
Desoxidation of the inner surface of the hollow
PHOSPHATHERM 3960 in powder form is injected with powder injection system by compressed air. It forms a scale protecting melting layer, which reduces the friction additionally. Furthermore the formed layer also prevents against secondary scaling.

Process step 2
Plug lubrication
with graphite free PHOSPHATHERM 906 powder onto the plug

Process step 3
Reeler Lubrication
PHOSPHAHERM 952, graphite containing suspension is sprayed into the tube before reeling
PHOSPHATHERM 916, colourless solution is added to the cooling water
We thank the following companies for providing pictures:

Vallourec & Mannesmann Tubes  
SMS Meer GmbH  
Bemers & Co.
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