Progress in typical materials for agricultural machinery

Club of Bologna, November 2005
Structure

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**The Organizational Structure of the KRONE Group**

**Advisory Board**
- Dr.-Ing. E.h. Bernard Krone (Chairman)
- Dr. Jürgen Föhrenbach (Executive Chairman of the Board)
- Dr. Wilhelm-Friedrich Holtgrave
- Arndt G. Kirchhoff

**Bernard Krone Holding GmbH & Co. KG**
- Heinrich-Krone-Straße 10, D-48480 Spelle
- **Alfons Veer** (Dipl.-Kfm.): CEO
- **Siegfried Wickert** (Dipl.-Ing. TU): Managing Director, Head of Production/Purchases/Human Resources
- **Gero Schulze Isfort** (Dipl.-Ing.): Managing Director, Marketing/Sales/PR

**Activities of Bernard Krone Holding GmbH & Co. KG**
- Corporate strategies/holdings
- Accounts/finance
- Controlling
- Marketing/advertising/PR
- IT/organization
- Legal affairs and patents
- Personnel
- Production/materials management

**Maschinenfabrik Bernard Krone GmbH**
- Heinrich-Krone-Straße 10, D-48480 Spelle
  - Equity: 39 Mil. €
  - Managing Directors: Wilhelm Voß (Dipl.-Ing. Agr.), CEO, Siegfried Wickert (Dipl.-Ing. TU)

**Krone NA INC**
- 4985 Outland Center Drive, Memphis, TN 38118/USA
  - Managing Directors: Rusty Fowler, Wilhelm Voß

**Krone Italia**
- Via del Commercio 33, I-37066 Sommacampagna
  - Managing Director: Stefano Castellani

**Fahrzeugwerk**
- Bernard-Krone-Straße 1, D-49757 Werlte
  - Equity: 51 Mil. €
  - Managing Directors: Siegfried Wickert (Dipl.-Ing. TU), Gero Schulze Isfort (Dipl.-Ing.)

**Bernard Krone A/S**
- Krogsgårdsvej 4-6, DK-8620 Kjellerup-Hvam
  - Equity: 10 Mil. €
  - Managing Director: Hans Søndergaard

**Secondo Trailer GmbH**
- Bernard-Krone-Straße 1, D-49757 Werlte
  - Managing Director: Bernd Schröer

**Krone France SAS**
- 2 rue Auguste Fresnel, F-69680 Chassieu
  - Managing Directors: Dr. Jürgen Föhrenbach (Dipl.-Vwt.), Bernard Richard

**Krone Finans A/S**
- Krogsgårdsvæj 2-4, DK-8620 Kjellerup-Hvam
  - Managing Director: Hans Søndergaard

**Landtechnik Vertrieb & Dienstleistungen**
- Bernard Krone GmbH
  - Bernard-Krone-Straße 20, D-48480 Spelle
  - Equity: 10 Mil. €
  - Managing Directors: Dorothee Krone (Dipl.-BW.), Ludger Gude

**Krone Italia**
- Via del Commercio 33, I-37066 Sommacampagna
  - Managing Director: Stefano Castellani

**Krone Finans A/S**
- Krogsgårdsvæj 2-4, DK-8620 Kjellerup-Hvam
  - Managing Director: Hans Søndergaard
Agricultural Machinery Division

Leader in technology for Hay & Forage equipment

Program:
- Full Line of Hay & Forage equipment
  - Mowers, Tedders, Rakes
  - Round & Large Square Balers
  - Forage Wagons
- Self-Propelled machinery
  - BiG M:
    First self propelled mower
  - BiG X:
    Most powerfull forage harvester

Employees: 761
Sales: 172 Mio. €
Commissioned Production

Program:
- Refrigerated trailers
- Semitrailers / Drawbar Trailers
- Container chassis
- Swap bodies
- Truck bodies
Trade/Service

Program:
Representation of leading Ag equipment, and supply’s Farmers, Contractors & Machine Rings

- Ground care machinery
- Agriculture spare parts service
- After sales service and Workshop
Sales Trend of the KRONE Group by Division

2002:
- Commercial Vehicles: 294
- Agricultural Machinery: 153
- Trading: 45

2003:
- Commercial Vehicles: 341
- Agricultural Machinery: 154
- Trading: 46

2004:
- Commercial Vehicles: 509
- Agricultural Machinery: 172
- Trading: 54

Sales in Mil. €
Regional Sales Breakdown: Agricultural Machinery Division, 2004

- Germany: 36%
- Central Europe: 32%
- Overseas: 20%
- Scandinavia: 5%
- Eastern Europe*: 7%

* Former Eastern Bloc
The Strongest Export Sales Countries 2004

USA
France
Austria
Italy
Netherlands
Japan
Australia
UK
Finland
Russia
Sweden
1. Introduction

Milestones of development

• Combination of several process steps in one machine.

• Oil hydraulic drives and controls.

• Electronic controls.

• Extreme increase in the performance of individual machines.
Reasons for development of material

• Higher load on the components due to increased machine performance.
• In parts, light-weight design is imperative on account of legal regulations and avoidance of soil compaction.
• Increase of the resistance to wear due to higher loads on components and higher area capacities.
• Increased demands on lifetime of professional agricultural machines.
• Increased demands on design and ergonomics of the machinery.
2. Groups of materials

2.1. Structural steels

Frames of fine-grained structural steel
## Material comparison of structural steels

<table>
<thead>
<tr>
<th>Designation</th>
<th>Apparent yielding point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIN (old)</strong></td>
<td><strong>EN</strong></td>
</tr>
<tr>
<td>USt 37-2</td>
<td>S235JRG1</td>
</tr>
<tr>
<td>St 52-3</td>
<td>S355J2G3</td>
</tr>
<tr>
<td>QStE 380 TM</td>
<td>S380MC</td>
</tr>
<tr>
<td>QStE 690 TM</td>
<td>S700MC</td>
</tr>
</tbody>
</table>
2.2. Alloyed steels

K 27V

42CrMo4V

18CrNiMo7-6
Non-Corroding Steels

Pre-compression rollers of Big X
made of X15CrNiSi2520

Metal Detector inside
2.3. Cast materials

ADI „austempered ductile iron“
2.4. Light alloys

Maize header EasyCollect

AlSi7MgO

Minus 120 kg!
Bearing housing of the swather tine arms

Minus 34 kg!

AlSi10Mg
2.5. Wear-resistant materials

Blades and Counterblades

Tungsten carbide bedded in a matrix of NiCrBSi
Wear plates

Hardened wear plates
Made of HARDOX
Corn Cracker
4.6. Plastics  Machine panelling
Hand laminate process of

glass-fibre reinforced plastic
Principle of the thermo-forming process

Both sides of the plate are heated until elastically mouldable.

Pre-stretching of the hot plate by blowing in compressed air.

The air between the plate and tool is drawn off until the plate completely contacts the mould. A cooling air blower is used to cool down the plate.

The shaped part is detached by blowing in compressed air.
The rotational moulding process
3. Abstract and outlook

Future developments

- Metal matrix composite materials
- Smart materials
  - Piezoelectric materials
  - Shape memory alloys

The shape memory effect
Thank you for your attention!