Innovation in Fully Automatic Billet Crack Detection and Removal Through Advanced Optical Recognition System and High Pressure Grinding

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Synopsis:
The automotive industry and other high quality steel application users demand crack free billets to ensure faultless products for further processing. Suppliers to those industry sectors also have to provide detailed and stringent quality documentation of the surface condition of each and every billet. To be able to do this, a reliable way to test the billet surface and an efficient method to remove existing cracks on the billets must be available. The BUCK Mecana NT system offers the fusion of the proven Mecana dry magnetic particle inspection system paired with a new sophisticated and innovative optical crack recognition system which is in operation in a German steel plant with proven results. Application of the system is not only to detect existing cracks on billets but also the reduction of cracks through optimization of the casting and rolling processes by adapting the relevant parameters. Existing cracks on billets can be ground fully automatic with the acquired data from the optical recognition system with state of the art high pressure grinding machines from SMS Logistiksysteme GmbH. The combination of the BUCK Mecana NT system and the high pressure grinding solutions of SMS Logistiksysteme offers an advanced fully automated crack detection and removal system.

Keywords: automatic detection of surface cracks, high-pressure grinding, automatic removal of surface cracks, inspection, conditioning

1. The BUCK Mecana NT Dry Magnetic Particle Inspection Process

Introduction
Based on the proven system performance of the Mecana system, BUCK has further developed and refined the method of magnetic particle inspection. The new improved system allows the testing of round corner square and round billets in a temperature range of -10°C up to 500°C for both longitudinal and transversal surface cracks. The crack coordinates are electronically recorded and stored for crack removal, quality documentation and process analysis and improvement.

In 2006, a reputed steel manufacturer in Germany with more than 25 years of experience in surface crack detection evaluated all available crack detection systems worldwide. Only the BUCK Mecana NT system was able to fulfil the advanced and stringent requirements to crack indication capability, detection probability and temperature range required by this user.

The system basics and performance quality results presented in chapter 1 are based on the operating experience of the proven BUCK Mecana NT system throughout the years and specifically on the experience of this steel plant in Germany.

The optical fault registration system described in chapter 2 of this paper is based on the system in use but with extensive innovations to the lighting/camera system and software capabilities.

Reasons for Surface Crack Detection
There are several important reasons for utilizing a crack detection system with the capabilities the BUCK Mecana NT offers.

The most important is the verification of the surface quality. Either the billet is flawless or cracks are present, detected and removed. With this ability, the required material quality, along with comprehensive quality documentation, can be delivered to offer an ultimate competitive advantage.

The second reason is the systematic collection of defects data as a basis for any quality

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improvement. Therefore, the rolling and/or casting processes can be improved and finally the amount of cracks produced by casting and rolling can be reduced. This requires the ability to detect transversal cracks, as almost all of the surface cracks on billets are created by the casting process and are in majority transversal. During the rolling process, depending on the cross section reduction, the transversal cracks are converted from transversal to angular or finally longitudinal cracks. It is therefore vital to reduce or eliminate transversal cracks during casting.

With all the improvements made in the casting/rolling processes, some defects will still be present on the billet surface. With the highly accurate and detailed crack coordinate information provided by the BUCK Mecana NT system, very selective grinding is possible. Selective grinding means lower material loss and therefore substantial cost savings, as well as higher throughput.

**Powder and Matching Lighting System**

The basic principle of magnetic powder inspection is that the billet is magnetized by an electric current in combination with magnetisable process powder. This specific method has been developed by the Mecana Company in Switzerland several decades ago and is still considered the best system for crack detection available. Figure 1 refers to the longitudinal crack detection; transversal crack detection follows the same principle. The magnetic lines run perpendicular to the induced electric current. If a surface crack is disturbing the magnetic lines, the resulting flux leakage attracts the magnetic process powder to form a powder bead at the crack.

To get the best possible crack image, an optimized pairing of process powder and lighting system is essential and one of the key elements of the system. The BUCK process powder consists of inorganic elements with white reflective pigments. It is suitable for use on billets with a temperature up to 500°C.

The powder has no limited shelf life. Deterioration due to e.g. high air humidity is not present and the powder is specially made by BUCK to suit the particular requirements.

Typical powder consumption is approx. 60 g/t, but can vary depending on the billet cross section size and surface condition of the tested billets.

Linear polarized light emitted by the LED flash uses the different reflections of metallic and non-metallic surfaces. The special pigments in the process powder accumulated in the cracks will depolarize the reflected light. This can be distinguished with a polarizing filter in front of the camera from the dark billet face.

**Layout and Process Cycle**

Refer to Figure 2 for information to the described system and layout.

The dry billets are fed from the upstream shot-blasting plant into the crack detection system by the in-feed levers and laid onto the inlet track rollers. The two contacting carriages close on the billet and with one motion, lift up the billet from the rollers and clamp the billet with a cross-section dependent clamping force. The reference marking system applies a small reference mark onto the billet. This reference mark serves as the surface definition feature for later grinding of the billet. To make sure that the reference mark is as small as possible and consistent regardless of billet size, an ultrasonic sensor is used to register when the grinder has touched the billet.

The magnetisation is then turned on and the two carriages move the billet into the powder chamber, where a number of nozzles spray powder onto the billet. The powder will accumulate on the cracks and also stick somewhat to the whole surface of the billet. All the powder not attached to a crack is...
removed with a slight air stream in the blow-off chamber adjacent to the powder chamber. The excessive powder in both chambers is collected and stored underneath in a powder supply compartment.

With very clear crack indications on the still magnetized billet, the next step in the process is the optical fault registration system OFRS. This innovative and advanced system is described in detail in chapter 2 of this paper.

Exiting the OFRS, the billet is grabbed by the billet brake after the magnetization has been turned off and held in position enabling the two carriages to release and lower the billet onto the outlet track rollers.

System Performance
The detection probability figures are based on the required system performance of the system in use at the reputed steel plant in Germany. Those values had to be guaranteed and have been achieved and verified.

Defining feature of the detection probability is the surface condition of the billet. A smooth, clean surface, as on rolled and shot blasted billets, allows for a clear and detailed crack picture.

The guaranteed detection probability in relation to longitudinal crack depth for a rolled, shot blasted and dry billet is shown in Figure 3.

For performance characteristics setting the BUCK Mecana NT system above the thermo-inductive systems, refer to Figure 4.

<table>
<thead>
<tr>
<th>BUCK Mecana NT</th>
<th>Thermo-inductive Systems [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of detectable cracks</td>
<td>Longitudinal</td>
</tr>
<tr>
<td>Orientation of cracks</td>
<td>Longitudinal, Transversal</td>
</tr>
<tr>
<td>Minimum crack length</td>
<td>≤5 mm</td>
</tr>
<tr>
<td>Temperature</td>
<td>max. 500°C</td>
</tr>
<tr>
<td>Types of billets</td>
<td>Continuous cast billets</td>
</tr>
<tr>
<td>Sensitivity to different surface temperature on the same billet</td>
<td>None</td>
</tr>
<tr>
<td>Crack Depth 0.2 mm</td>
<td>80%</td>
</tr>
<tr>
<td>Crack Depth 0.3 mm</td>
<td>96%</td>
</tr>
<tr>
<td>Crack Depth 0.35 mm</td>
<td>100%</td>
</tr>
<tr>
<td>Crack Depth 0.4 mm</td>
<td>100%</td>
</tr>
<tr>
<td>Crack Depth 0.5 mm</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 4: Comparison chart

2. Optical Fault Registration System OFRS

Mechanical Hardware
The OFRS system can be divided into two parts: the OFRS housing unit (Figure 5) placed in the BUCK Mecana NT plant, and the computer cabinet in the control room.

Inside the OFRS housing, perpendicular to the billet faces, four LED-camera modules are arranged. The LED-camera modules consist of a LED flash unit with over 300 individual LED lights and industrial GigE-camera, both equipped with filters to produce and distinguish linear polarized light. The two lower units are fixed, as the lower edge of the billet is always (ignoring billet deviation) on the same level. Due to different cross sections of billets, the two upper units are attached to linear drive carriages. The housing is constructed as a very sturdy welded tubular frame with welded on sheet metal covers. To keep unwanted dust away from the cameras and flashes the housing is slightly pressurized. The system can, depending on environmental conditions, also be equipped with a heater and/or air conditioner.

Access to the linear drives with the LED-camera units is by lockable, sealed doors. For an ergonomic maintenance position, the linear drives are pivotable and swing out from the vertical into a horizontal position.

Also placed in the OFRS housing are some electrical hardware components enabling communication between the cameras, the micro controller and the computer cabinet. All those parts are mounted on a drawer which is accessible through a lockable maintenance door.
The computer cabinet consists of at least five industrial workstations. One is acting as the server and four are used as camera workstations (at least one per camera). The required communication interfaces to the OFRS housing and the superordinate plant control, as well as a keyboard and monitor is arranged in this cabinet.

The two units are linked by a fibre optics cable to cover large distances and to ensure error-free communication.

Software and Crack Recognition Sequence

The server workstation, responsible for providing the interface to the superordinate plant control and for the supervision of the subordinate processes on the camera workstations, receives a telegram with information of billet size and applicable recognition parameters. The relevant parameters are distributed; all software modules are made available for receiving data from the optical recognition system. After starting the picture taking process, a picture of each billet side is made every 200 mm. Those pictures are sent to the individual camera workstations and are analysed. The billet edges are determined and the cracks identified by the advanced recognition algorithms. The crack coordinates along with other relevant data is stored in a file which is, along with the processed pictures, sent to the server. As soon as all four camera workstations report the end of analysing the pictures and successful transfer of files to the server, a new sequence can be started.

An independent software module takes all the pictures and crack detection results and merges it into one complete picture for each billet side. Those pictures can be accessed and visually analysed with a viewer module on three ‘pages’ with different capabilities to either get an overview or a detailed view of the billet faces with the crack markings and also an actual camera picture superimposed with the crack markings.

The coordinates generated by the merger module are used for the automatic grinding and the data can be made available for statistical analysis enabling the systematic collection of process records.

Special Features

One of the biggest advantages over competitor systems is the absolute billet edge recognition capability: The results of the crack detection will always be displayed and the coordinates stored in the absolute correct position, regardless of the position of the billet in relation to the cameras. Deviations in straightness, angular deviation due to torsion and billet end irregularities are compensated.

In addition to the capabilities described above, another aspect setting this system above the competitors is the fact that the software can be adapted to changing needs of the user. Initial delivery contains a number of different recognition parameter sets that can be adapted to the specific crack pictures found on the billets at the user plant.

The whole system, software as well as electrical hardware, is designed to be scalable. Base set-up is one workstation per camera, processor modules evenly distributed to the number of cores of the workstation. Processing pictures, detecting cracks and edge recognition takes a certain amount of execution time. If there are many cracks, the processing time will increase and the cycle time may suffer. Adding one workstation per camera (total of 2 workstations per camera or more) will result in more available cores and processor modules to distribute the workload. Processing time will be decreased this way.

Process supervision

The supervision of the whole process is of paramount importance in today’s quality requirements.

Should unnoticed no powder be applied to the billet, no cracks can be found.

A safeguard against this scenario is the base luminosity feature. Background of this feature is that, even if there are no cracks to be found on a billet, some powder particles will stick to the surfaces of the billet resulting in what is commonly described as the ‘starry sky’ effect. This can be reliably
detected. If the ‘starry sky’ is not present with working magnetization, no powder is applied and a warning can be sent to the main plant control.

Every software module and communication component has self-diagnostic capability. If any problem is encountered, the system will notify the superordinate plant control.

All these features of the BUCK Mecana NT system ensure a very secure and controllable process performance.

3. High Pressure Grinding for Semi-Finished Products

For the removal of surface defects on cast and rolled semi finished steel products high pressure grinding today is the most effective technology. It is still required despite of all improvements in casting due to increased quality requirements of the end customer and the permanent development of new steel grades. The field of application reaches from selective grinding of defects up to full surface grinding of complete surfaces. By the selection of the machine settings and the grinding wheel properties reproducible grinding results can be reached for each steel grade. The quality achieved is essential for the use of the final products rolled or forged by the semis for sophisticated application such as in the automotive sector.

Alternative processes cannot provide the same quality or throughput (manual grinding, grinding by robots) or cannot be applied due to metallurgical reason for high alloy grades (scarfing).

The influencing factors on the grinding process can be seen from Figure 6, a scheme that is used in many publications [2, 3].

**Grinding Machine**

SMS Logistiksysteme today follows a grinding concept which can be characterized by the workpiece performing the reversing motion clamped on a grinding table while the grinding unit is arranged in a fixed position only performing the crossfeed. The grinding operation is therefore concentrated on a fixed location which is enclosed by a noise, dust and chips protection hood. This provides the possibility for the selective deducting and chips removal at the origin of its formation.

The especially designed gearbox grinding wheel drive by SMS Logistiksysteme allows the realization of high power rates only limited by the ability of the grinding wheel to transmit the power onto the workpiece. Nevertheless for the selective grinding of defects and the grinding of the corners precise control at lower power rates is also important not to create holes on the surface or the destroy the corner.

**Grinding Parameters**

Beside the principal design of the machine during grinding the grinding result can be influenced by the grinding parameters. The parameters to be set are:

- the grinding pressure related to the motor power (e.g. 2 -20 kN at 20 - 200 kW),
- the crossfeed of the grinding head (e.g. 5 - 50 mm per pass) and
- the grinding table speed (10 - 80 m/s).

The grinding pressure is directly related to the removal rate. To reach high removal rates typically a combination of high pressure and wide crossfeed is chosen.

High removal rates typically go along with coarse surface. If the focus is more on smooth surface than on removal rate a combination of low crossfeed, high table speed and low pressure is chosen. This also applies for the selective defect grinding.

If a combination of both - high removal rate and smooth surface - has to be reached two passes or more maybe performed on the workpiece. This excessive grinding operation only can be justified for high quality steel grades.

**Grinding Wheel**

The grinding result is strongly dependent on the selection of the grinding wheel. The grinding wheel is formed of the abrasive and the bond by hotpressing. The abrasive consists of tough corundum grades while the bond is based on phenolic resins [2].

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*Figure 6: Factors influencing the Grinding Process [2, 3]*
The abrasive performs the grinding operation by cutting into the material. During grinding the abrasive particles lose their sharpness. It is therefore essential that the worn abrasive is constantly released from the bond so that new sharp abrasives continue the grinding action. This so called “self sharpening” process, which is also dependent on the grinding pressure and the table speed, happens best at grinding wheel peripheral speed of 80 m/s.

Beside the material of the abrasive and the bond the grinding result is influenced by the grid size of the abrasive. Grit sizes are available from range 6 to 30 where low grit size indicates coarser grains and high grid size indicates finer grains. Coarse grains are to achieve high removal rates. If the grinding result should be a fine surface roughness finer grids are selected at cost of removal rate [2, 3].

**Workpiece**

Beside of the final application of the steel product the requirement for grinding is dependent on the addiction of different steel grades to produce surface defects during casting or rolling. There are grades which hardly need to be ground. Other grades do not only produce defects during casting or rolling but also when cooling down after casting.

Consequently also the grindability depends on the steel grade. Grinding is typically performed on high alloy carbon steel for springs, bearings, tools, bars and wire rod or on stainless steel. In general carbon steel is easier to grind than stainless.

**Grinding Process**

The combination of all the influencing factors described above lead to the grinding result defined by the following parameters:

- The removal rate defines the amount of material ground of in a period of time when the grinding wheel is in contact. It is related to the grinding motor power.
- The surface quality is expressed by the roughness $R_z$. Typically the surface roughness for semi finished steel products after grinding is sufficient in the range of $R_z \approx 120 \, \mu m$ or higher. Nevertheless for special requirements it is possible to reach surface roughness $R_z < 40 \, \mu m$ by high pressure grinding.
- Though the wheel wear does not characterize the grinding result related to the workpiece this parameter is important to evaluate the economic efficiency of the grinding process together with the removal rate and the surface quality. The wheel wear is typically expressed by the Q-factor (also defined as G-factor).

The goal of each grinding process is therefore to optimize removal rate, surface quality and wheel wear according to the grinding requirements in the economically most efficient way.

It can be observed that grinding in general is a production technique which is characterized by complex processes during cutting and a high number of influencing factors. Prediction of the grinding result only based on theoretical considerations is consequently difficult. Grinding therefore is still an empirical science and experience is the key for the design of the process.

### 4. SMS Logistiksysteme - State of the Art in High Pressure Grinding

SMS Logistiksysteme’s know how in grinding technology is based on over 50 years of experience in the design of grinding machines worldwide. The field of application reaches from carbon to stainless steel billets and slabs as well as special size ingots and blooms. In the following typical design features for billet grinding machines will be described which are decisive for the technological leadership of SMS Logistiksysteme grinding systems.

The product range reaches from single stand alone grinding machines up to complete billet conditioning lines which also include the inspection of billets on surface and inner defects upstream of grinding. A typical high pressure grinding machine can be seen in **Figure 7**.

**Figure 7**: SMS Logistiksysteme high pressure grinding machine at VAC / Germany

**Grinding Unit**

The grinding unit is based on the machine stand which is a solid welded structure that at its rear end turns into the chips collecting box, **Figure 8**. The unit is consisting of the grinding carriage and the grinding pendulum. The grinding pendulum locates the grinding motor which drives the grinding wheel via coupling and gearbox. The chips that are created during grinding will be collected and recycled. A fine dust filtering system is connected so that dust can be sucked of selectively.
Figure 8: Grinding Unit with machine stand and chips collecting box

**Direct Grinding Wheel Drive by Angular Gear**

A special design feature of the SMS Logistiksysteme grinding system is the direct drive of the grinding wheel by angular gear. The development of this drive has led to a new generation of high power grinding machines with motor power only limited by the ability of the grinding wheel to transmit the power onto the workpiece. The power can be transmitted much more effectively than with belt driven systems used in the past. The gearbox is connected to an oil circulation lubrication which not only provides the lubrication of the system but also the cooling. As the gearbox is permanently cooled the machine can be operated constantly at maximum power.

Due to the fact that the system is enclosed no dust can enter. The belts used in the past were exposed to the dusty atmosphere within the grinding hood and therefore they had to be exchanged quite frequently. This caused downtimes of the machine.

The gearbox does not only provide advantages in regards of power and maintenance but also on the grinding process itself. As the vibrations are much lower than with belt driven systems the surface quality is much better.

The advantages of the gearbox drive in summary are:

- application of high power of e.g. 200 kW or higher in constant operation
- low need for maintenance
- less vibration and therefore high surface quality
- precise control of the grinding process
- high resistance against grinding wheel bursts

**Frequency Controlled Grinding Wheel Drive**

The peripheral speed of the grinding wheel is kept constant at 80 m/s dependent on the diameter of the wheel. This is the value mentioned before recommended by the grinding wheel suppliers where the wheel provides best grinding performance.

In addition the service life of the grinding wheel is extended by up to 30% compared to a grinding wheel drive of constant rotational speed. Moreover, the grinding values and surface quality remain unchanged during the complete service life of the grinding wheel.

**Grinding Control by Power or Pressure Control**

SMS Logistiksysteme grinding machines can be operated with two control modes. In the power mode the controlled process variable is the motor power. According to the preset command variable the motor power is kept constant during the whole grinding process. Grinding in power mode is used when the machine should be operated at maximum power grinding the full surface of the billet.

In the fine control range of the machine rather pressure mode is chosen. The controlled process variable is the grinding pressure measured on the grinding cylinder which is kept constant according to the preset command variable. Pressure mode provides best grinding results for the selective grinding of defects or for the grinding of the corners of the billet.

In both grinding modes the grinding head follows the shape of the billet. That way even grinding depth and surface quality is guaranteed over the whole length even if bended billets are processed by the machine, Figure 9.

Figure 9: Grinding wheel in power mode grinding full surface
Drive of the Grinding Table by Electric Geared Motors

Another innovation that SMS Logistiksysteme integrated into their design is the drive of the grinding table by electric motors. In the past there have been rope driven systems connected to a hydraulic motor. These systems required excessive foundation works for the guidance of the rope. The foundations which were hardly accessible for cleaning were often contaminated by grease used for the rope.

With the new electric drive of the grinding table these problems are overcome. The rails for the table today can be fixed directly on mill floor so that no foundation pits are required. The motors are easily accessible for maintenance purposes. During grinding high acceleration combined with good positioning accuracy is provided.

The advantages of the grinding table drive by electric geared motors are:

• no foundation pits since rails are fixed on mill floor
• no contamination of foundations by oil or grease
• motors easily accessible for maintenance
• high positioning accuracy during grinding
• low need of oil and grease
• energy efficient power transmission

Safety Concept

SMS Logistiksysteme is committed to a concept of safety to protect the operator and all components of the machine.

The grinder is fitted with a safety device preventing the grinding heads from dropping down in the event of a power breakdown. The grinding head will then lift up immediately by gravitational forces.

Due to the production process of grinding wheels there is a low rate of wheels that burst during grinding. For this case the machine needs to be prepared. First of all the heaviest pieces of the wheel will be captured by the grinding wheel protection hood which covers the wheel during grinding (figure 9). For the safety of the operator he is observing the grinding operation through a bullet proof window, Figure 10.

Environmental Compatibility

The operation of machines in compliance with environmental requirements becomes more and more important worldwide. As the grinding operation is enclosed by the protection hood noise can be deadened and dust can be collected selectively.

5. Combination of BUCK Mecana NT System and SMS Logistiksysteme Grinding Machines to Fully Automatic Conditioning Plant

The principle contradiction of surface conditioning by grinding or other technologies is that the required quality is produced on the one side and yield loss is created on the other. The objective to run the process in the most economical way therefore has to be to provide the surface quality required and to minimize the yield loss at the same time.

Today common practise in most steel plants is still the grinding of the full surface based on empirical data of defect position and depth. Though the billets might be inspected by rather unreliable detection systems, full surface grinding often will be applied anyways to be on the safe side that all defects are removed, especially for high quality grades.

As a result a breakthrough in economic efficiency can be reached if the cracks can be identified and removed selectively. The BUCK Mecana NT system with automatic camera identification by OFRS provides a worldwide unique solution for the reliable and reproducible recognition of cracks in any direction. Moreover the position of cracks can be stored and the data can be forwarded to the downstream grinding machines by SMS Logistiksysteme. Figure 11 shows one possible layout solution of such an integrated system.
The billets produced by casting or rolling will be loaded onto the billet conditioning line by overhead crane (1). Before the inspection shotblasting is required to remove scale from the surface (5). The billet can be inspected for inner defects by ultrasonic inspection in a first step (6). Billets with inner defects can be directly sent to billet sorting station (3) and sorted out as bad billets. After cross transfer (2) the billets will be inspected for surface cracks in the BUCK Mecana NT system (7). If no cracks will be observed billets can be sorted out as good billets (3). The billets on which cracks have been found will be forwarded to the grinding machines (8). Here cracks will be ground selectively. After grinding, the billets will be picked up from the unloading station (4) of the grinding machine by overhead crane to be transported to the storage yard.

The line can be easily adapted to the requirements of the steel plant. If higher conditioning capacity is required the line can be extended by further grinding machines.

The conditioning line can be operated with different level of automation.

### Automatic Inspection with Selective Grinding by Visualization System

The cracks identified by the BUCK Mecana NT system are shown on a display unit arranged in the operator’s cabin of the grinding machine. The movements of the grinding table, where the billet is attached to, are synchronized with the display unit. The operator uses the machine’s joysticks to approach and grind the cracks. To examine if the crack has been successfully ground, a special lighting system supports the operator with the visual checking. This combination enables the manual selective grinding of defects but also the full surface grinding if the rate of defects exceeds a limit to be defined. An initial decision of the applicable grinding method is made by the crack detection system and relayed to the operator, who can accept or override the system’s choice.

### Automatic Inspection and Grinding System

The crack coordinates determined by the crack detection system can be forwarded to the grinding machines control system to grind the cracks automatically. The grinding machine approaches the cracks in both longitudinal and transversal billet direction with the coordinate data and carries out the grinding task. The operator’s task is only to supervise the process.

The successful removal of cracks can be controlled automatically by using the crack removal detection system, a combination of industrial camera, special lighting and adapted software.

This combination provides the highest level of automation with the ability to partially grind the cracks or fully grind the surfaces as well as the round corners of the billet.

The material tracking system required for an automated operation process will also provide the possibility to record and store the result of the inspection and the subsequent grinding process as the history related to each billet. The billet conditioning could then be part of an integrated quality management system through the whole production process until the final product and application.

Another advantage recording the inspection data of each billet is that the data can be related to the upstream production process. A feedback on the casting and/or rolling process can be expected which might result in further optimization and less cracks during production. In a best possible way to think the billet conditioning line makes itself to become obsolete.

### Conclusion and Outlook

The BUCK Mecana NT surface inspection system in combination with grinding machines by SMS Logistiksysteme provides the following advantages/possibilities:

- **The BUCK Mecana NT is the only available crack detection system with such high capabilities in recognition rate in relation to crack depth and length, direction of cracks and testing temperature**
• Fully automatic inspection and grinding by integration of both processes
• Flexible solutions for customer requirements

For the implementation of such an integrated billet conditioning line the return on investment results from the following effects:
• Reduced yield loss due to selective grinding of defects
• Increased quality of products and possibility to claim higher prices on the market
• Access to new markets that require high quality steel products
• Improvements of the upstream casting and/or rolling process will support the effects listed

List of Citation:
2) Slip Naxos Steel Conditioning (2005), Companies Brochure