Worn knife seatings in the best of hands

Laser cladding is the "knight in shining armour" for a sawmill

It's all go in the timber processing industry. Every day, in a non-stop process, one after another, countless logs of up to 22 metres in length are debarked, measured to the intended format of the final product and processed into lumber. The extreme stress on the equipment and tools in the production line used for this process is something about which the company Gebr. Eigelshoven GmbH & Co. KG – a state-of-the-art sawmill in Würselen near Aachen with more than 130 years of tradition in the trade – can tell a thing or two. When it comes to repairing heavily worn circular knife tool-holding fixtures, their go-to solution is laser cladding performed by Pallas GmbH & Co. KG, a proven specialist in the repair of highly stressed components.

Founded in 1887 by the clog manufacturer Gottfried Eigelshoven, in 1918 the factory was enlarged to include a sawmill and a cereal mill. In 1940, the first bandsaw was installed. The entire factory burnt to the ground in 2000, but within a year was re-erected and equipped with state-of-the-art technology on a site 20 percent larger than the original site. Even with this enlargement, the new factory's available surface area of 70,000 square metres is still considerably smaller than other timber mills with a comparably high output. Maintaining an annual output of 220,000 cubic metres of trimmed timber – in other words a daily throughput of 1,000 cubic metres on the quadroline bandsaw – calls for a maximum of logistical finesse. Up to 28 trucks per day drop off the raw material – round logs exclusively sourced from sustainably managed forests – and pick up an

equivalent amount of finished product and mill residues. Currently, the 100-strong staff are processing wood – about 80 percent of it spruce and 20 percent Douglas fir – for structural timberwork. 95 percent of the output is dimensional lumber, i.e. raw material for construction timber, substructures, battens or shuttering formwork. Cut-to-size timber in a variety of formats, packaged according to customer-specific parts lists, and trade items complete the range of products. The mill's customers range from small, domestic companies to internationally operating bulk buyers. About 50 percent of the customers are located in Germany, 30 percent in the neighbouring Benelux countries, a further 10 percent in France and Great Britain and the rest abroad. Apart from having all the relevant certifications, Eigelshoven has an excellent reputation for the high quality of its processing and treatment, for tightest dimensional tolerances and consistently high surface quality. Its exclusively customer-specific production is the guarantee for made-to-measure, just-in-time deliveries and the required high level of throughput. The management of this family business is firmly in the hands of the fourth and fifth generation of Eigelshovens.

From tree trunk to ready-to-dispatch structural timber

The felled logs are delivered to the log yard, where they are loaded onto the plant, then separated and reduced, i.e. the trumpet shaped end of the log is milled down. They then pass through the debarker and a first metal detector that inspects the logs for metal splinters, nails or munition. Then the logs are first measured per laser to establish their length and diameter as well as any special features like warp or ovality. These measurement data are then assigned to the customer orders in the next stage, the cross-cutting station. This computer-based process determines simultaneously which lengths of which logs are to be cross-cut for which customer orders.

A gantry crane transports the debarked and cross-cut logs to the sawmill, where they pass through a second metal detector. In the sawmill, the complete customer order is loaded into the quadroline mill – four bandsaws with a magnetic guidance system. In an inline process, each log then passes through the 80-metre-long and 15-metre-wide bandsaw line at a feed rate of 28 to 105 metres per minute. First, another two-stage 3D laser measuring system identifies the individual log. On the basis of the optimal cutting plan previously established – also per laser - the log is then automatically rotated into its correct orientation. In the next stage, the chipper canter removes two opposing curved sides of the log. The circular knives used for this process are held in tool-holding fixtures. By means of a computer-aided nesting plan, the bandsaw then cuts the product from the middle of the log according to the customer's order, and also further useful cuts from the rest of the material. In the next stage, the log is rotated through 90 degrees and a second chipper canter removes the other two curved sides. The result: a rectangular block of wood. This is then divided into boards by a variable circular saw with one horizontal and six vertical axes. In the sorting unit, unusable pieces are sorted out and then stacked and banded for delivery to the customer. Finally, the cut-to-size lumber passes through a range of finishing stations like planing, exact truncation with millimetre precision, fully automated six-axis processing (joining), bath impregnation and drying.

Tool-holding fixtures set the pace for speed and quality

A throughput of 1,000 cubic metres a day implies extreme stress for the circular knife tool-holding fixtures in the chipper canter. This is where the rough surface of the log – residual bark, irregularities or branches – is milled to an even surface. The roughness is ablated by four 15 x 28-centimetre knives fixed into a cast iron rotor disk which measures 750

millimetres across and is 300 millimetres thick. Another four smaller knives – measuring just 7 x 7 centimetres – are deployed for the smoothing action. These are attached to the rotor disk by means of rectangular tool-holding fixtures. The knives are exchanged every day – just like all the mill's saw blades – and resharpened in Eigelshoven's own grinding shop. When it comes to cut quality and speed, the seatings that hold the small knives in the cutters in the rotor disk are of critical importance. The wear and tear due to the constant friction tends, over time, to create damaged spots on the right and the left of the tool clamping. Wood gets into these recesses and renders the cut unusable due to torn out bits of wood fibre. At the same time, the performance of the machine is diminished, and this puts maintenance of the required daily throughput at risk. In view of the high costs involved in replacing one of these tool holders, Rainer Oprei, Technical Director at Eigelshoven, has long been on the lookout for a durable repair option. After all, the mill has a total of four of these rotary cutter heads in operation on a daily basis. But he was sceptical – due to bad experiences with initial repair attempts – as to whether such a durable repair option even existed. Then, he witnessed the success Pallas achieved in their treatment of several shafts with bearing damage – and this encouraged him to give the idea another try. When one of the tool holders had to be replaced due to wear and tear, he turned to Pallas and found competent and motivated counterparts in Stephan Kalawrytinos, Managing Director of Pallas, and Rodion Honisch, Head of the Laser Division. They suggested a surface reconstruction of the damaged structures by means of laser cladding. Using strictly localised heat input, this generative process facilitates high-precision surface coating with minimal warpage. The coating material is applied through concentrically arranged nozzles to the surface area to be treated and melted together with the base material. In this so-called melt pool, the two materials join

metallurgically into a dense coating with low dilution. Moreover, the near-net-contour quality of the applied coating means that post-processing costs are kept to a minimum.

Point by point to success

One particular challenge that Pallas faced was that the tool holders had no basis. In addition, the tool clampings were not only worn to different degrees. The hardness in the worn areas also had an extremely inhomogeneous distribution, with differences in hardness of up to 40 HRC. For this reason, Pallas decided to experiment on all four tool-holding fixtures with different working materials that had differing corrosion resistance and material hardness grades ranging from 50 to 63 HRC. However, the heterogeneous surface condition of the worn tool-holding fixtures did not permit any continuous coating with high-speed steels, which meant that more manual processing would be needed. Rodion Honisch developed a modular programme for the 6-kW diode laser to be used for the task, and this allowed him to adapt the laser pulsing to the specific configuration of the worn area. In this way, he could choose where to begin with the reconstruction: on the flanks, or on the lower edge. In laser pulsing, very short controlled bursts – the laser only flashes for just 200 milliseconds – apply the energy selectively to the material in order to repair complex geometries point by point. Thanks to the near-net-contour quality of the process, the coated tool-holding fixtures required only minimal post-processing, which was done with a Dremel. All in all, the repair of each tool clamping took at least eight hours.

No wear after a year of continuous operation

Rainer Oprei installed these repaired circular knife tool holders in one of the sawmill's chipper canters in order to test the durability of the laser cladding

under the tough conditions of the machine's daily operation. One year later, he examined the wear and tear – and was surprised by what he found. One of the four knife seatings that had been processed by Pallas showed no signs of wear and tear at all; the other three only infinitesimal traces. Normally, after a year in operation, circular knife tool holders are completely worn down. Rainer Oprei was delighted, and commissioned Pallas with the repair of a further, much more worn circular knife tool holder – this time using the particular working material that had proved itself best in the first repair. For Pallas, the follow-up order also meant having to find a way to reduce the required manual processing in order to ensure the cost-effectiveness of the repair for both sides. The problem lay in the form of the knife seating, which impeded a suitable positioning of the laser head. In view of the wear pattern, Rodion Honisch therefore decided to homogenise the surface to be treated by first milling out the wear points. The milled-out recess – up to seven millimetres deep – had to be designed so that the applied reconstruction coating would meld firmly enough to the base material. The solution was a special processing technique that he developed. Because the knife seating was extremely worn, the coating specialist's first step was to create a slightly raised connecting edge of austenitic stainless steel 1.4404 (316L), on which he then reconstructed the worn basic structure of the tool-holding fixture. On this, he then applied high-speed steel with a hardness grade of 63 HRC as wear protection.

This surface-treated cast iron rotor has now been back in operation at Eigelshoven for a month. Rainer Oprei is confident that it will more than fulfil his expectations of a long service life. And he is full of praise for the "enthusiasm with which Pallas took on this task, and their willingness to take risks". The positive result and an 80-percent saving on costs compared to buying a new unit also spoke for the chosen solution. Optimal preconditions for the sawmill to entrust the surface engineering experts with

a new – and by no means less challenging – task. The bed knives on the hacker are to be given durable wear protection by means of laser cladding. Rainer Oprei knows that, with Pallas, his worn knives are in the best of hands.

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Pallas GmbH & Co. KG

The company Pallas GmbH & Co. KG, headquartered in Würselen near Aachen, is a technological leader in the field of surface engineering that offers a complete range of surface treatment processes from a single source: electroplating, thermal coating, non-stick and plastic coating as well as laser treatment. By combining the advantages of thermal, mechanical and electromagnetic procedures and working materials, Pallas develops application-specifically optimised surfaces for heavy-duty components or tools. For over 50 years now, this owner-managed family business with its circa 35 employees has regularly set new standards in the field of technical and decorative surfaces. In key industrial applications like tool- and mould-making, for sealing and bearing seats, rollers or drill pipes, Pallas offers the attractive option of rapid repair as an alternative to time- and cost-intensive replacement with brand new components.

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Verschlissene Messersitze in besten Händen

Laserauftragschweißen als Rettung in der Not für ein Sägewerk

Bild 1: Pallas reparierte die Verschleißstellen an der 750 Millimeter großen, 300 Millimeter dicken Kreismesser-aufnahme mit Laserauftragschweißen.

Bild 2-3: Durch eng begrenzten Wärmeeintrag ermöglicht Laserauftragschweißen eine hochpräzise Beschichtung und den Wiederaufbau von beschädigten Strukturen.

Bild 4-5: Der Beschichtungswerkstoff wird durch konzentrisch angeordnete Düsen gefördert und an der Beschichtungsfläche zusammen mit dem Grundwerkstoff an- beziehungsweise umgeschmolzen.

Bild 6: Pallas trug Schnellarbeitsstahl mit 63 HRC als Verschleißschutz auf die Kreismesseraufnahmen.

Bild 1-6: © Pallas GmbH & Co. KG

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Bild 7: Bis zu 28 LKW pro Tag bringen bei Eigelshoven den Holzrohstoff und holen die analoge Menge an Fertigware und Reststoffen wieder ab.

Bild 8: Die Messdaten des 3D-Lasers werden in der Kappstation computergestützt den Kundenaufträgen zugeordnet.

Bild 9: Per Laser werden die Stämme erstmals vermessen, um neben Länge und Durchmesser auch Besonderheiten wie Krümmung oder Ovalität zu erfassen.

Bild 10: Die angelieferten Stämme durchlaufen die Entrindungsmaschine.

Bild 11: Ein erster Metalldetektor untersucht die Stämme auf Metallsplitter, Nägel und Munition.

Bild 12: Ein Portalkran befördert die gekappten Aufträge zum Sägewerk.

Bild 7-12: © Pallas GmbH & Co. KG

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Bild 13: Die Stämme auf dem Weg zur Quadroline-Anlage.

Bild 14: Die Stämme durchlaufen einen zweiten Metalldetektor.

Bild 15: Im Sägewerk wird der Kundenauftrag komplett in die Quadroline-Anlage – vier Bandsägen mit Magnetführung – geladen.

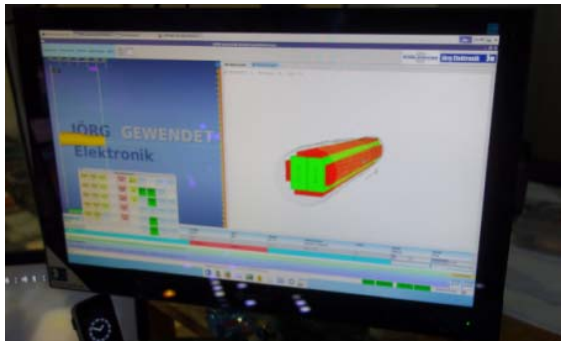

Bild 16-17: Eine erneute, zweistufige 3D-Laservermessung identifiziert den Einzelstamm und entsprechend der ebenfalls per Laser ermittelten optimalen Schnittplanung wird er dann automatisch eingedreht.

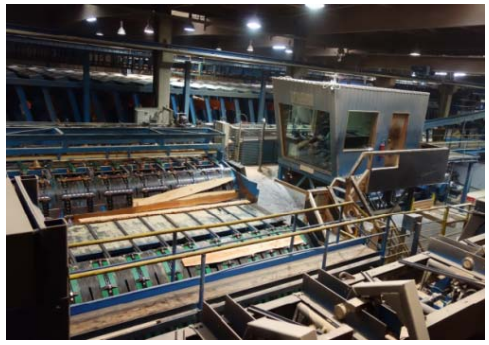

Bild 18: In einem Inline-Prozess durchläuft jeder Stamm die 80 Meter lange und 15 Meter breite Bandsägenlinie mit 28 bis 105 Meter Vorschub pro Minute.

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Bild 19: Der Spaner entfernt zwei gegenüberliegende Rundseiten des Stamms: Die dafür eingesetzten Schneidwerkzeuge sind in der Kreismesseraufnahme befestigt.

Bild 20: Die Reparatur der Kreismesseraufnahmen durch Pallas spart rund 80 Prozent Kosten gegenüber einer Neuanschaffung ein.

Bild 21: Die Bandsäge schneidet aus der Stammmitte das Kundenprodukt sowie aus dem verbliebenen Material weitere nutzbare Stücke.

Bild 22-23: Die insgesamt vier Kreismesseraufnahmen sind extremen Bedingungen ausgesetzt: Hier werden Rindenreste und Unebenheiten entfernt und die Rundungen zu geraden Flächen geschnitten.

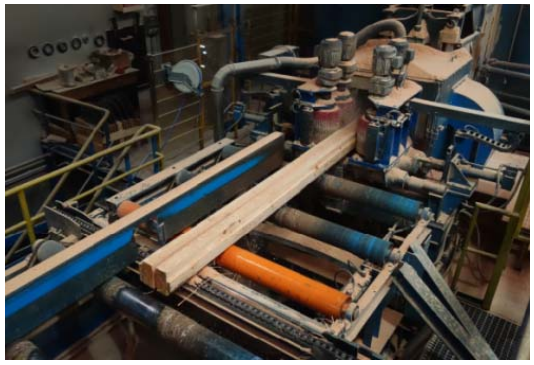

Bild 24: Ein zweiter Spaner trennt die verbliebenen Rundseiten ab, sodass ein rechteckiger Holzblock entsteht.

Bild 25: Die Feinbearbeitung übernimmt eine Kreissäge.

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Bild 26: Die Bretter werden den Kundenaufträgen automatisch zugeordnet.

Bild 27: Die zugeschnittenen Bretter durchlaufen diverse Veredelungsstationen wie Hobel oder millimetergenaue Fixkappung.

Bild 28: Im Vakuumtrockner wird Bauholz mit unterschiedlichen Dimensionen getrocknet.

Bild 29: In den Trockenkammern wird das Holz getrocknet, um es für den Innenausbau nutzbar zu machen.

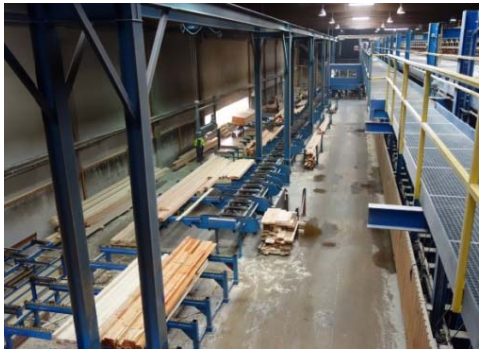

Bild 30: Die zugeschnittenen Bretter werden sortiert.

Bild 31: Zum Versand an den Kunden werden die Bretter gestapelt und umreift.

Bild 26-31: © Pallas GmbH & Co. KG

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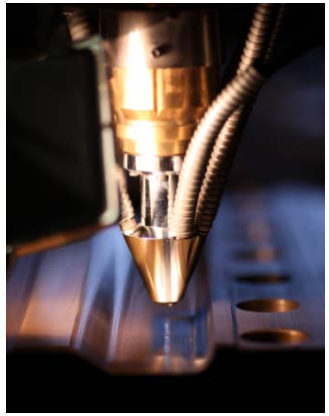

Bild 32-33: Für den 6 kW Diodenlaser entwickelte Pallas ein modulares Programm, das es dem Oberflächenspezialist erlaubte, an die Verschleißstruktur angepasst zu pulsen.

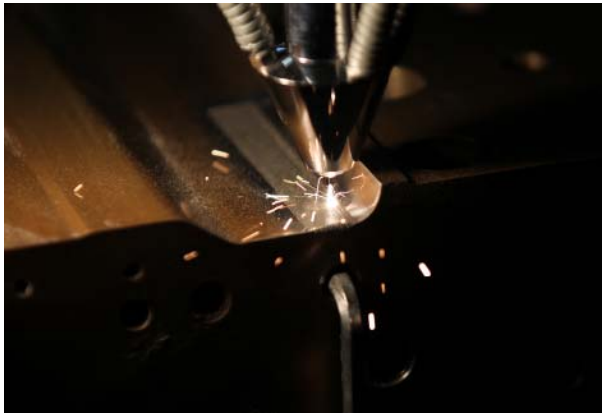

Bild 34: Beim Pulsen wird durch einen zeitlich eng begrenzten Impuls die Energie punktuell in das Material eingebracht, um so komplexe Geometrien zu reparieren.

Bild 35: Carolin Eigelshoven-Lauel führt mit ihrer Familie das Sägewerk Eigelshoven in der fünften Generation.

Bild 36: Rainer Oprei, Technischer Leiter bei Eigelshoven, weiß seine verschlissenen Messer bei Pallas in besten Händen.

Bild 37: Rodion Honisch, Leiter der Abteilung Laser, leitete bei Pallas das Projekt.

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