Perfect interaction

500 MN drop-forging press puts on the pressure - with heavy plate from Dillinger

Krefeld's press specialist Siempelkamp Maschinen- und Anlagenbau GmbH set two records simultaneously with its construction of a 50,000 tonne drop-forging press: the casting of 320 tonnes of molten iron in the group's own foundry for the largest press of its type manufactured up to now in Germany broke the previous world record. Capabilities that the project suppliers also had to keep pace with. Once again, Siempelkamp put its trust in heavy plate from Dillinger. Europe's market leader in the extra-thick plate sector for the first time supplied plates of 510 millimetre in thickness for the pressure distribution plates and the drive table of this mega-scale press. Despite the extreme plate thickness, Dillinger nonetheless guaranteed mechanical properties as specified under the EN 10025 standard for plates up to a maximum thickness of 400 millimetre. Concentrated high-level capability from two top companies in their fields, and thus optimum preconditions for a press which is to operate with both high precision and extreme reliability for many decades as the central element in a new forging plant for China's Nanshan Group.

Siempelkamp, a global player in the supply of technological equipment, with 3,000 employees, of whom 950 in Krefeld, specialises in four main fields: not only all-in systems for processing of wood and wood-based materials, but also special presses for the rubber industry, composite systems and large-format presses for metalworking. At its Krefeld headquarters, single-source design, engineering, construction, transportation, installation and commissioning assure maximum possible reliability for the production process and the product. This is also confirmed by the many projects successfully completed by this expert in XXL-size drop-forging presses. The company has now once again demonstrated its outstanding capabilities internationally with the supply of a 50,000 tonne drop-forging press for a subsidiary of China's Nanshan group: Nanshan Aluminium is among the leading users of aluminium and titanium alloys for the production of structural components for use in the aerospace industry. Nanshan commissioned

Siempelkamp to construct a complete 500 MN large-format press for a new forging plant at Longkou, in China's Shandong Province. The decisive factor in the award of the order to the Krefeld technology wizards was, in particular, Siempelkamp's proven capabilities in the casting of large components and in subsequent machining of the extreme item weights involved. Nanshan uses the largest drop-forging press ever built up to now in Germany for the production of near-net forged components for the Airbus 380 long-haul airliner. In addition to turbine disks, these also include so-called *"inner wings"*, which connect the wings to the fuselage, and must therefore assure not only high-precision forming but also ultra-high strength. Near-net production of these large-format components from the extremely difficult-to-form materials, and thus the meeting of the plane maker's stringent requirements, necessitates the use of a press that sets new standards in press force and format.

Presses show their capabilities

For Christoph Schmitz, head of the Mechanical Design group at Siempelkamp, this 50,000 tonne press is entirely in line with the trend: "Manufacturers are demanding drop-forging presses with ever great force, press area and precision - and with the highest possible cycle rates". Siempelkamp also designed the new press for China under his leadership. Just a few of Nanshan's technical specifications, such as passage height, the unobstructed clearance of the side spacings, the passage height of the pressure distribution plates and the 4 x 7 metre dimensions of the press table indicate the size of this machine. The intended application - the shaping of structural components from titanium, titanium-aluminium or Inconel at 500 meganewton and a tolerance of 0.05 millimetre - put the details into the challenge involved. Almost routine for Christoph Schmitz, Siempelkamp having only recently shipped a 450 and a 400 meganewton press. "There's no need to invent a new press for 'only' 10,000 tonnes of extra press force!", he laughs. The design principle - a robust press frame consisting of the lower beam, lateral supports, upper beam and tie rods – is tailored to meet the loads specified by the customer", the university-trained engineer continues. Such individual design makes every XXL press a one-off created on the basis of close coordination and cooperation between the design, FEM calculation, foundry and production engineers at Siempelkamp. At

the end of this process, not only the structure and dimensions of the press, but also the forces necessary for the specific application and therefore the power requirement of the press, are defined. After the completion of planning and calculation, the design department forwards the project to the pattern-making team. "A pattern like this soon takes on the scale of a small single-family house", Christoph Schmitz notes. Impressions are taken of the finished wooden pattern using quartz sand, and the casting then made. For this 500 meganewton press, a total of twenty-six large components were successively cast in ductile cast iron at Siempelkamp's Krefeld foundry. As a global specialist in this technology, Siempelkamp was able to assure optimum achievement of the complex geometries needed - as flexurally stiff as necessary, but with thinnest possible structural thicknesses at less heavily stressed points. The two lower beams, at 287 tonnes finished weight each, were the heaviest contenders. Casting of them, using 320 tonnes of molten iron delivered in five teeming ladles, brought Siempelkamp a new world record. Almost "routine" for the foundry, on the other hand, were the middleweight components for the Nanshan press, such as the two foundation stools, each of 80 tonnes finished weight. Set against this, the four locking supports, each of 'only' eight tonnes finished weight, could almost be regarded as "flyweights". Large castings, such as those for the press for Nanshan, need around four weeks to cool in the sand pit after casting.

Heavy plate puts on the pressure

For the following large-scale machining operation, the components were taken to the machining shop only 400 metres away on the same site on a heavy-duty multi-axle trailer. In addition to the necessary crane capacities, which are capable of lifting 480 tonnes, they were also met here by an extensive range of large-format CNC machines, including a gantry-type machining centre. Siempelkamp is to deliver the 500 meganewton press as a complete all-in unit, and the entire automation, hydraulic and control systems are therefore also assembled in Krefeld. This assures not only perfect interaction of the individual components with one another, but also trouble-free installation on the site in China. Nanshan has set demanding specifications: a 280 tonne component may not exceed a tolerance of 10 millimetres, even under exposure to heat. The 2,500 reciprocating tonnes of the moving beam are driven by eight hydraulic cylinders, each of them

exerting a press force of 6,250 tonnes. Four retraction cylinders, which are designed to achieve precisely the specified eccentricity and lift the moving beam, are necessary to apply the 50,000 tonnes as uniformly as possible to the customer's forming die of 1,000 millimetres diameter. Equally critical is the positioning accuracy of the drive table and moving beam in lowering the 2,500 tonne load at the defined rate of 190 millimetres per second. The 500 meganewton Nanshan press forms only one large structural component per press cycle. It features an additional internal and external line injector for the production of smaller components, such as turbine disks. Pressure distribution plates calculated using the Finite Element Method (FEM) ensure that the specified tolerances of between 0.5 and 1 millimetre are met. "With an 11 metre long moving beam and a tolerance of 1 millimetre per metre, the moving beam may flex only by a maximum of 11 millimetres when 50,000 tonnes of press force are applied", adds Christoph Schmitz, illustrating the challenges involved. All the pressure distribution plates and the line injector were fabricated from Grade S355JR+N heavy steel plate supplied by Dillinger. The latter was Siempelkamp's partner of choice for this project, in view of the need to produce heavy plates in a thickness of over 500 millimetre with demanding mechanical properties and deliver them "just in time" within a very narrow time window. "We know, thanks to our many years of cooperation with Dillinger, that we will get the promised quality with total reliability", affirms Friedhelm Wittenberg, the responsible buyer at Siempelkamp. "The competition can simply not even approach this quality". A total of twelve such heavy plates were used, each with as-cast weights of 39 tonnes and more. "The thicker the plates, the better the pressure distribution", Friedhelm Wittenberg continues. Specific requirements, such as finished dimensions, delivery dates and sequences, mechanical data and a reduced carbon equivalent, were all defined on the basis of intensive interchange with Dillinger. Production of plates of this thickness was a "first", even for the world's quality and technology leader in the heavy plate sector. Extremely thick homogenous feed material was cast to order and rolled to finished dimensions under enormous forces in order to assure mechanical properties analogous to those specified in EN 10025 for plate thicknesses of up to 400 millimetres, despite the plate thickness of 510 millimetres for this project. Correspondingly modified rolling-pass schedules made it possible to deform the centre of the

plates to the extreme extent required. This also permitted assured adherence to Siempelkamp's expected flatness tolerances of 13 millimetres across the entire surface area. The highly respectable length of 4.080 mm was not sufficient for some of the components needed for the 500 meganewton press, with the result that Siempelkamp welded three of these plates together using the electroslag welding method for the pressure distribution plates. After final machining, finished dimensions of 4,000 x 7,000 millimetres, with a thickness of 480 millimetres, were achieved. The calculation, design, production, inspection and packing of all 8.000 tonnes of components for the 500 meganewton drop-forging press consumed a total of 40,000 man hours of work. The experts in Krefeld were also responsible for shipment to China, installation and commissioning. In the final analysis, a truly great achievement, made possible only thanks to absolutely perfect interaction between the units within Siempelkamp and partners such as Dillinger.

10.930 characters incl. spaces

For more information:
Dillinger
Dr.-Ing. Wolfram Hölbling
Telephone: +49 (0)6831/47-47 08
Telefax: +49 (0)6831/47-99 20 25
e-mail: wolfram.hoelbling@dillinger.biz
AG der Dillinger Hüttenwerke
66748 Dillingen/Saar
Germany
POB 15 80

Free for press reproduction, please send copy to:
impetus.PR
Ursula Herrling-Tusch
Charlottenburger Allee 27-29
D-52068 Aachen
Germany
Telephone: +49 (0) 241/189 25-10
Telefax: +49 (0) 241/189 25-29
e-mail: herrling-tusch@impetus-pr.de
www.impetus-pr.de