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TOUGHER CASTING

MATERIALS WITH HIGH THERMAL FATIGUE RESISTANCE ARE TOUGHER THAN USUAL STEELS. MACHINING THEM COST EFFECTIVELY IS A CHALLENGE.

BY **BINDU GOPAL RAO**

WITH STATE-OF-THE-ART TOOLING FACILITIES, the die and mould industry is one of the most advanced with in-house design capability for moulds. The industry also has 3D based design process with high level of standardisation. With design facilities fully integrated with CAM and the ability to secure data control through access controlled servers, this is helping the industry reduce cycle times and lead times, lower labour costs with unattended machining. When industries such as the automotive and aerospace change designs regularly, machining centres need to mill hard metals at record speed, and are also required to make moulds of the hardest steels and other materials. Dies, moulds and tools are an important aspect of the production process across industries and are the foundation of any kind of manufacturing.

We speak to industry experts to understand the machines used and the challenges faced.

MEAN MACHINES

The die and mould industry has a broad spectrum of equipment including additive manufacturing/3D printing, CNC milling/machining centre, EDM, die/mould polishing/die spotting machines, heat treatment systems, hot runner system, injection moulding machines, measuring machines, metrology moulding machines/die casting machines, sheet metal presses & ancillaries, CAD/CAM systems, coating machines, cutting tools, digitising systems, press

1. Advancements in tools are helping manufacturers machine accurately.

tools, rapid prototyping & tooling, surface treatment systems, texturising systems and tool steel systems. At Godrej Tooling, some of the high-end machines include metal cutting, a high-speed CNC milling and large double column CNC milling with tilt heads and index tables, EDM for erosion and wire cuts and Blue Light scanner, CMM with programmable controls, laser calibration and ball bar equipment for quality assurance. These are supported by CAD-CAM software for off line programming.

EOS is the global technology leader for industrial 3D printing of metals and polymers and an innovator for holistic solutions in additive manufacturing. System, material and process parameters are intelligently harmonised to ensure high quality of parts thus facilitating a decisive competitive edge.

EOS nurtures a vibrant ecosystem of partners and, by means of venture investments, helps incubate promising start-ups. It's this interaction along the industrial value-chain that enables the development of extensive solutions for 3D printing. "We produce innovative and high quality products using Direct Metal Laser Sintering (DMLS) technology. We have developed some cutting-edge products such as the EOS M 290 and EOS M 400-4 that are enabling us cater to this industry." said Anand Prakasam, head, EOS India.

The EOS M 290 and the M400-4 are the high end machines which help in production of die casting. These machines allow fast, flexible and cost-effective production of metal parts directly from CAD data. It has an intuitive user interface as the intelligent software concept with a combination of open and

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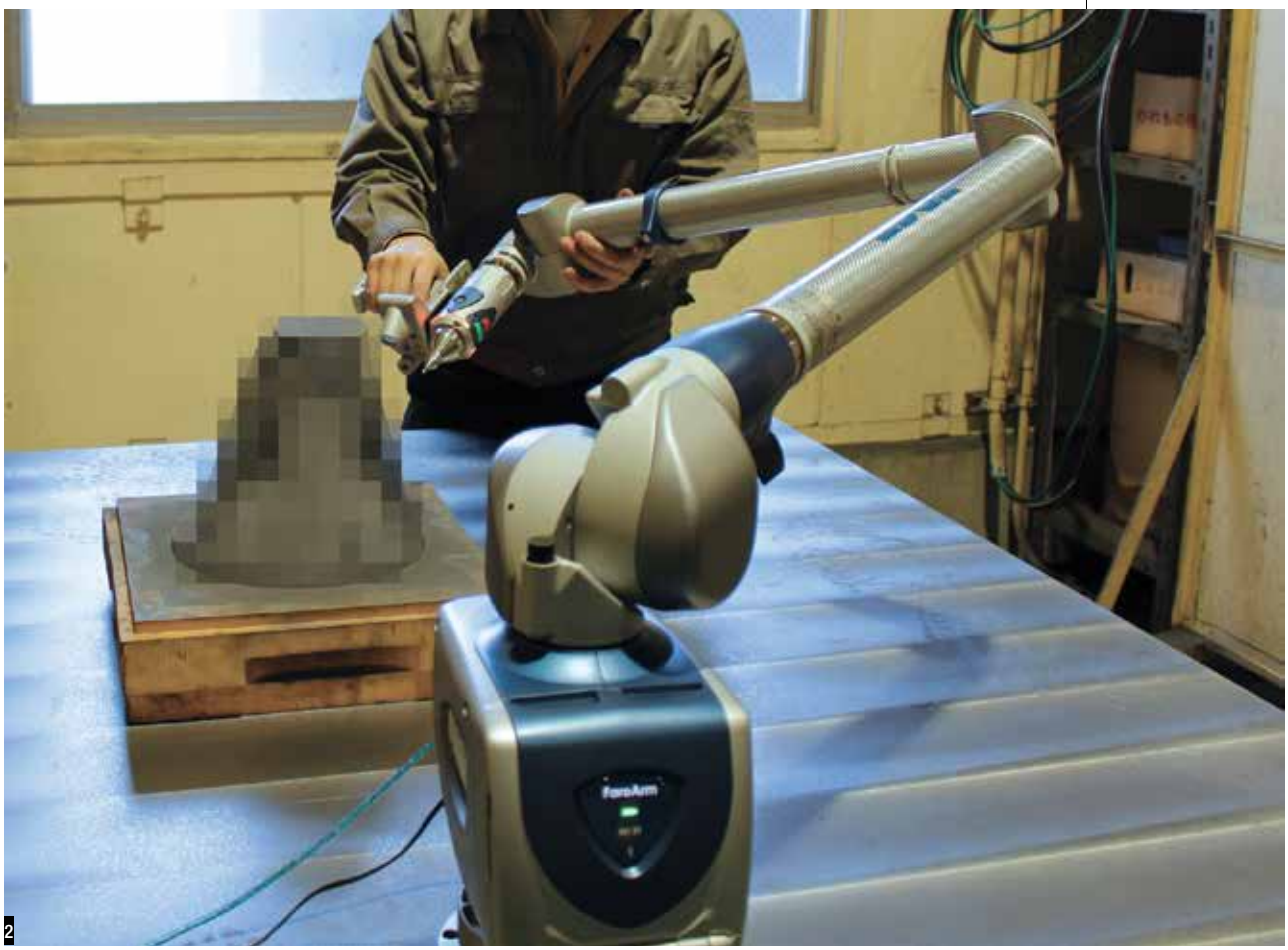

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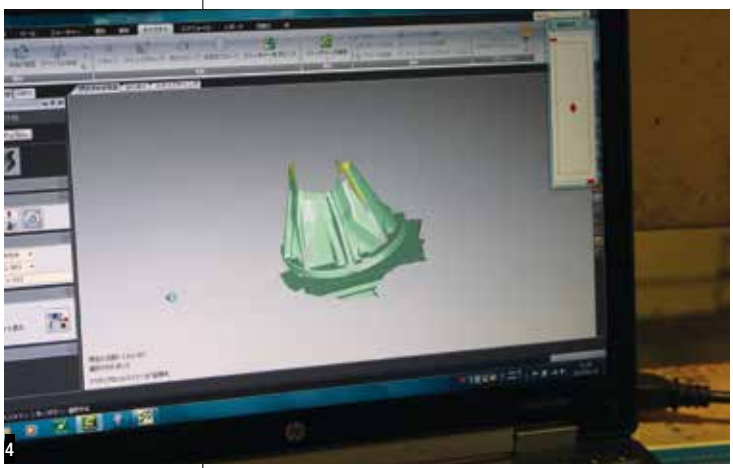

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3. There is a constant challenge to work out the lead times considering regular design changes.

4. MSMEs and SMEs need to invest in technology to check accuracy of the mould.

standardised parameter sets and the improved self cleaning filter system specially designed for the industrial production. The company has also entered into a strategic cooperation with GF Machining Solutions. This allows them to increase the value for customers by integrating conventional and additive technologies.

MATERIAL CHALLENGES

In spite of several kinds of machinery, there is a need to constantly evolve. Considering that designs in the auto and aerospace industry change constantly, there is a challenge of working out the lead times for die and mould. "The lead time is calculated with standard rope lengths with certain wait time. They are rescheduled as and when changes are demanded by customers. In certain cases, the wait time buffers are used with tighter rope length plans to meet customer needs. In an event where capacity becomes a constraint, sub-contracting to approved and trained vendors is done," said DK Sharma, executive VP & business head, Godrej Tooling.

Likewise, in die casting dies, materials with higher thermal fatigue resistance are tougher than usual tool steels. Machining them in a cost effective and timely manner is a challenge. Sheet metal dies for high strength part requires cutting of hardened steels at 55-60Hrc. To cut these accurately and cost effectively is a challenge. A deviation in geometry leads to higher tool maker efforts in part proving. CAE analysis of high strength parts (dp >590 pascals) requires multiple iterations and may still demand multiple trials and correction cycles. HPDC castings with complex features and high quality material filling properties that demand innovative filling, venting and cooling arrangement as per CAE flow analysis. "Most of the times we use close materials to the actual injection moulded parts. Having said that, there are a lot of clients who require the exact material parts for testing and certification. Due to the restrictions on the

technology this becomes a challenge sometimes for us and the customer," opined Nishant Shah, director, engineering, Imaginarium India.

MANAGING LEAD TIME

The industrial 3D printers are used to produce functional parts in a small batch production followed by mass productions. Tooling is an area that highly benefits from additive manufacturing. Special tools need high technical attention, processes and incur high costs. The design benefits of additive manufacturing from EOS increase both the productivity of the tools and the plastic product quality.

In many industries, the production of specialist tools is one of the most expensive aspects of the production processes. It is time consuming and technically demanding to use conventional processes. Based on EOS additive manufacturing, the company enables single parts or individualised serial products to be manufactured quickly, cost-effectively and flexibly – even in small batch sizes. The overall lead time for the production of die or mould using additive manufacturing is at least 50-70% faster when compared to conventional tooling given that the design of the die is suitable for the AM technology. "By hybrid production, we mean the complicated part of the die or mould which need a 5-axis machining or wire EDM or multiple settings can be produced using additive manufacturing method and the simpler half can be milled. Another effective hybrid manufacturing is to effectively build only the functional areas of the tool on a pre machined base. With such different technique the AM technology is able to support the production of dies and molds even when the design changes constantly. Effectively using DMLS design rules the dies and moulds could be redesigned quickly to adapt to suit AM. "For example, Innomia managed to reduce the time-to-market from 18 to 13 days in comparison with conventional tool manufacture as part of a tool optimisation project by using additive manufacturing," opined Prakasam.

LOOKING AHEAD

3D printing has made its mark in the tool and die industry. Reduction of lead times, faster mouldings, precision prototypes for qualification and study are just a few benefits of this technology. The importance is so great that one of the leading German CNC machine manufacturers has come up with a hybrid technology wherein the same machine can be used to deposit metal material and machine it on a 5-axis bed!

Additive manufacturing is taking a huge leap in the die and mould industry. The importance of plastic as well as metal 3D printing is being realised by manufacturers as well as consumers. This is not only for

6 & 7. A typical shop floor for die & mould that has sophisticated equipment and high-end CNC machines.

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NEW GEN MANUFACTURING USES HARD MACHINING ON MULTI AXIS MACHINING CENTRES.

prototypes but also for manufacturing moulds directly. “For example, we recently printed an entire Mould (core and cavity) in Digital ABS for a bottle which was to be blow moulded. The outputs produced could be around 500 in number, and showcased great quality. The mould took 2 days to design and 1.5 days to print. Similarly, metal 3D printing has now become an important process for conformal cooling in moulds. For serial production tools, there’s been a reduction of 30-35% in cycle times using conformal cooling; which is a huge saving! Also we are continuously innovating and trying to see if we can print simpler moulds in metal, considering the material available are maraging steel, aluminium and titanium, which can help reduce the lead time drastically for pilot and low volume production tools,” added Shah.

Machines that are able to cut as per design intents in minimum number of set ups and faster than present time lines, viz., 5-axis machining centers that are already in vogue. “IoT and digitisation for higher machine up times, real time data availability for faster and educated decisions on machine as well as part conditions are way forward. Integrating machines with the MIS systems and automation for repeatedly accurate executions will help scale-up. A network supply chain for effective resource deployment is also very helpful,” avered Sharma.

The industry is also changing, to meet customer expectations that mandate a fast turnaround in the manufacture of dies & moulds. New generation manufacturing extensively uses hard machining and complex profiling on multi axis machining centres that do not need much manual intervention. The industry is certainly all geared to meet new customer expectations to take things to the next level. MT

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CASE STUDY

Moulding is a crucial process in aerospace and automotive industries. Common forms include press moulding and injection moulding, and most cars require more than 300 different moulds. In die and mould, Japanese-made moulds are recognised for quality. In fact Japan-based Saito Mold & Die Factory had a great experience using a FARO product. During Saito’s search for a new solution, a distributor introduced one of FARO’s portable CMM – the FARO Edge ScanArm ES. Right at the product demonstration, it became clear that the 3D measurement device would be a perfect fit for the measurement needs that Saito had. Kiyoshi Saito, president, Saito, exclaimed, “I’ve found it – this is it! FARO’s device is easy to operate and not restricted to just a select few engineers. With the speed that measurements can be acquired, we can save a great deal of time.” One of the main benefits that Saito enjoyed about the ScanArm ES was its portability. As the device can be brought to any production site for measurement, it won the team over readily. Saito had originally considered imaging technology measurement devices, but an inherent shortcoming was the fixed nature of those devices. As moulds easily weigh up to hundreds of kilograms, it would have been difficult and time consuming to move and position them onto a machine. Moreover, the work would require frequent rotation of the mould to capture various sides of the object, further necessitating an easier way to measure the weighty moulds. With a portable CMM like the ScanArm ES, the operator can move the arm to scan an object easily, completing the measurement in a much shorter time. “If any rework is required after an inspection, the mould returns to the processing machine immediately,” added President Saito. “It is very important to measure quickly.”