HOW METAL 3D PRINTERS ARE USED IN MANUFACTURING ①

3D PRINTING BOOSTS PRODUCTIVITY IN THE AUTOMOTIVE INDUSTRY

One of the key industries in the Korean economy is the automotive industry. As competition in the global market is intense, the automotive industry is one of those industries that are quick to introduce new technologies for the purposes of improving quality and productivity. So, as part of our first installment of ‘How Metal 3D Printers are used in Manufacturing,’ let's take a look at how the automotive industry uses 3D printers to solve new problems.
Editor_Kim Sol, Source_InssTek

The birth of a new technology called 3D printing was accompanied by immediate and earth-shattering expectations. Many people thought that they could create something entirely new in an entirely new way. But there was something people overlooked. It was the fact that the introduction of a new technology requires a lot of research and careful planning induced by the recognition of internal issues that plague an entity. This is a natural process which takes place ahead of investing in any equipment. It seems, however, 3D printers were considered an exception and not subject to such process. People completely isolated 3D printers from the existing production systems and thought only about what to do with 3D printers alone. The false sense that amazing innovations will become a reality at the hands of a new 3D printer has prompted several organizations to approach this new technology in an abnormal manner.
Instead of thinking about what to make with 3D printers, industry observers say they need to approach 3D printing technology as a solution to problems that could not be solved by conventional methods. 3D printing technology has a variety of attributes that can potentially solve a myriad of problems in the field. As such, if specific problems can be set forward, it can be utilized as a practical solution.

The three-part 'How Metal 3D Printers are used in Manufacturing’ series gets under way with this article. In this article, we work along with InssTek, a leading 3D metal printing company, to present examples of companies that are already solving old problems by innovating work processes using 3D printers. Why don’t we check out how companies in these articles are saving time and money with 3D printers, and finding ways to innovate our own organizations? The first industry field to open the series is the automotive industry.

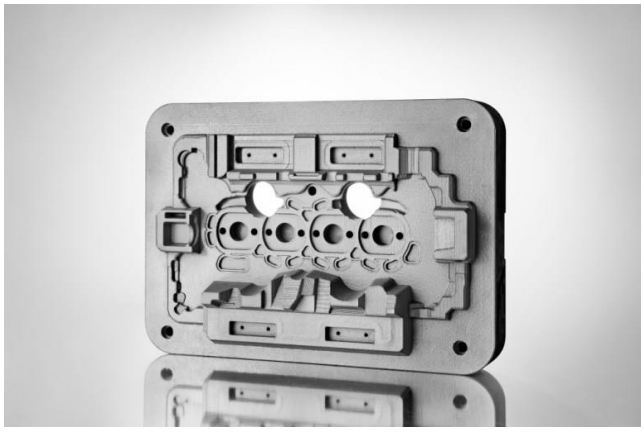
HOW TO PRODUCE MORE CYLINDER HEADS WITH A SINGLE MOLD

Cylinder blocks and cylinder heads are key components of automobile engines. They both require high strength as they are required to withstand the explosive pressure and temperature when fuel combusts. Cylinder blocks and cylinder heads manufactured using the casting method are usually made of cast iron. But, aluminum alloy is also used depending on the demand for weight reduction

and high performance.

Company A also produces cylinder heads with aluminum die casting. It, however, was suffering from corrosion on its mold surface as corrosive gas was being produced during the casting process. Since this company wanted to increase die life by improving the resistance against corrosion in its molds, it chose to use a **dissimilar alloy** with the help of 3D printers. The DMT® 3D printing technology based on Directed Energy Deposition (DED) used by InssTek is a method in which involves creating a molten pool by irradiating the metal surface with a laser, completely melting the metal powder supplied to the molten pool, then solidifying it rapidly. Because of the perfect bonding between the layers, mechanical properties are similar or better than forged materials. As such, it can produce a stable dissimilar alloy between different metals.

Company A machined the H13 (SKD61) material using InssTek's 3D printing technology and then printed Hastelloy, a nickel alloy material with high corrosion resistance, only on surfaces prone to corrosion. Since the company printed expensive materials only on the required parts, it yielded remarkable results at minimal cost. Here, the biggest achievement was that the mold's life nearly doubled. Corrosion resistance was improved and the mold's life, which previously lasted one year, was extended to two years. In fact, the company says it is still using the four sets of molds made back in 2015. In addition, it alleviated aluminum sintering reduced the number of defects stemming from thermal, thereby improving productivity as well as quality.



HOW TO REDUCE LEAD TIME IN THE AUTOMOBILE PARTS INJECTION PROCESS

One of the best-known advantages of 3D printing is that it enables the production of products without any restrictions. It is easy to create very complicated and demanding figures/shapes that were difficult to achieve using conventional methods. The best example that illustrates this is the **3D cooling channel technology** for molds. Using existing gun-drill processing method, it was difficult to control the temperature of mods. With 3D printing technology, however, a highly efficient cooling channel can be created within any mold, no matter how complex and geometric its structure is. As such, companies can improve quality by reducing deformation and shrinkage of its products. Not only that, they can shorten the cooling time and the lead time, therefore improving productivity.

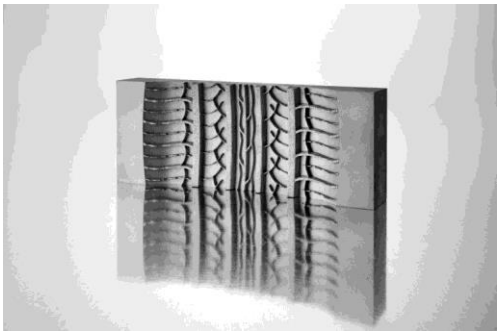
In the automotive industry, molds are used to manufacture a number of parts such as head lamps and dashboards. If these parts are manufactured using smart molds featuring 3D cooling water channels, quality and productivity will improve dramatically. A head lamp injection process using a smart mold is a good example. The lead time, which was 20 minutes when using an existing mold, was shortened by 40% to 13 minutes. As such, the 3D cooling water channel that improves productivity and quality can be applied to a variety of fields such as injection molding dies, die casting molds, and hot stamping.

HOW TO PREPARE FOR FREQUENT DESIGN CHANGES TO HEADLAMP MOLDS

Company B, a well-known Korean automobile manufacturer, wanted to solve cost and time issues caused by frequent design changes in the process of developing and manufacturing headlamp molds. Every time the design changed, not only did it take a long time to re-manufacture a new mold, but it also cost more than KRW 15 million (USD 15,000). Therefore, the company introduced a **hybrid 3D printing** method which 3D printed the same kind of metal powder onto the base of P21 steel material. This enabled it to change designs freely without having to produce new molds. The production period, which took four weeks in total, was shortened to a single day, and the cost of production, which stood at KRW 15 million (USD 15,000) per mold, was cut to KRW 2 million (USD 2,000), a drop by 80%.

Whether it is cutting or forming, the Hybrid 3D printing method is capable of repair metal products that have worn down, thanks to its ability to be molded directly onto metal, no matter what process it has already undergone previously. The connecting rod trim punch repair case, where service life increased more than twofold from 20,000 ~ 60,000 shots to 150,000 after worn-down parts were repaired using InssTek's DMT® printing, proves the effectiveness of Hybrid 3D printing.

There are more examples of 3D printing technology successfully solving real-world manufacturing problems in the automotive industry than those covered in this article. In addition, the use of 3D



printing technology in the automotive industry is expected to continue to grow moving forward, as it is actively used in the research and development of aluminum rear covers, tire molds, and lightweight parts. Now, 3D printing has become more than just a pipe dream. It has become a 'solution' that saves time and money in the manufacturing business.