August 30, 2016

Aichi Steel Corporation

Commercialization of Dy-free Bonded MAGFINE® Magnet using Innovative "Direct Injection" Manufacturing Method

-Adopted for MAKITA Cordless Chainsaw-

Aichi Steel Corporation (HQ: Tokai City, CEO: Takahiro Fujioka) developed MAGFINE®, a bonded magnet free of the heavy rare earth element Dysprosium (Dy), in 2010 and manufactures all stages from powder to bonded magnets. The freedom of shape and high electrical resistivity offered by these bonded magnets, are attractive for customers, allowing them to optimize their motor designs and greatly simplify their manufacturing processes.

To date, motors using MAGFINE® range widely from small motors with 10s of watts of power to high power, high efficiency motors of several hundred kilowatts (10times the power of typical HV motors).

Aichi Steel first established the innovative MAGFINE® manufacturing process of "direct injection" (※2) with its adoption by Makita Corporation (HQ: Anjo, Japan; CEO: Shiro Hori) for their Cordless Grass Trimmer in September 2015.

The second application of this technology is the Makita Cordless Chainsaw motor.

In addition to the freedom of shape (1) and simplification of manufacturing ((2), (3)) being critical in MAGFINE® being chosen over conventional sintered Neodymium (Nd) material as was the case in the first application, by utilizing a common cross section and changing the length of the motor to increase the motor power (4) in this development it was possible to streamline both the design and manufacturing processes and contribute to the product's cost competitiveness.

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1. "Direct injection molding" allows the design of the ideal magnet cross section to maximize the magnetic force of MAGFINE® and maintain motor performance with the same size as conventional technology (motor using sintered Nd magnets)
2. Direct injection of MAGFINE® into the rotor core (laminated steel) making up the motor provides fixing strength that eliminates the need for the gluing process in motor assembly.
3. The technology to align (※4) the magnet particles during injection molding also works to magnetize the magnet, eliminating the need for the magnetization process in motor assembly.
4. By simply changing an insert in the molding die to match the height of the rotor core, it is easy to accommodate magnets of different heights and produce magnet assemblies (※5) for motors of varying outputs.

We intend to expand into applications such as home appliances, energy and automotive by taking a different direction to motor designs that use simple shaped slabs of sintered neodymium and enable motor designers to realize ideal magnet shapes through Direct Injection Molding of MAGFINE®.

Further, with Dy free MAGFINE® bonded magnets becoming more widely available; the use of heavy rare earth elements whose supply is unstable will be reduced, bringing low cost and stable supply to customers while benefiting the earth's environment.

※1 Dy free bonded magnet MAGFINE®: A magnet formed by fixing Neodymium anisotropic bonded magnet powder grains produced without the heavy rare earth Dysprosium in various types of plastic.

※2 Direct injection molding: A molding method where heated resin is injected into a die

※3 Rotor core (laminated steel): a part made of stacked die-cut electrical steel, where the height of the part can be changed by changing the number of sheets

※4 Alignment: Aligning the direction of magnetization of magnet powder grains to increase magnetic power

※5 Magnet assembly: A component made up of a magnet and rotor core (laminated steel)

<Reference materials>

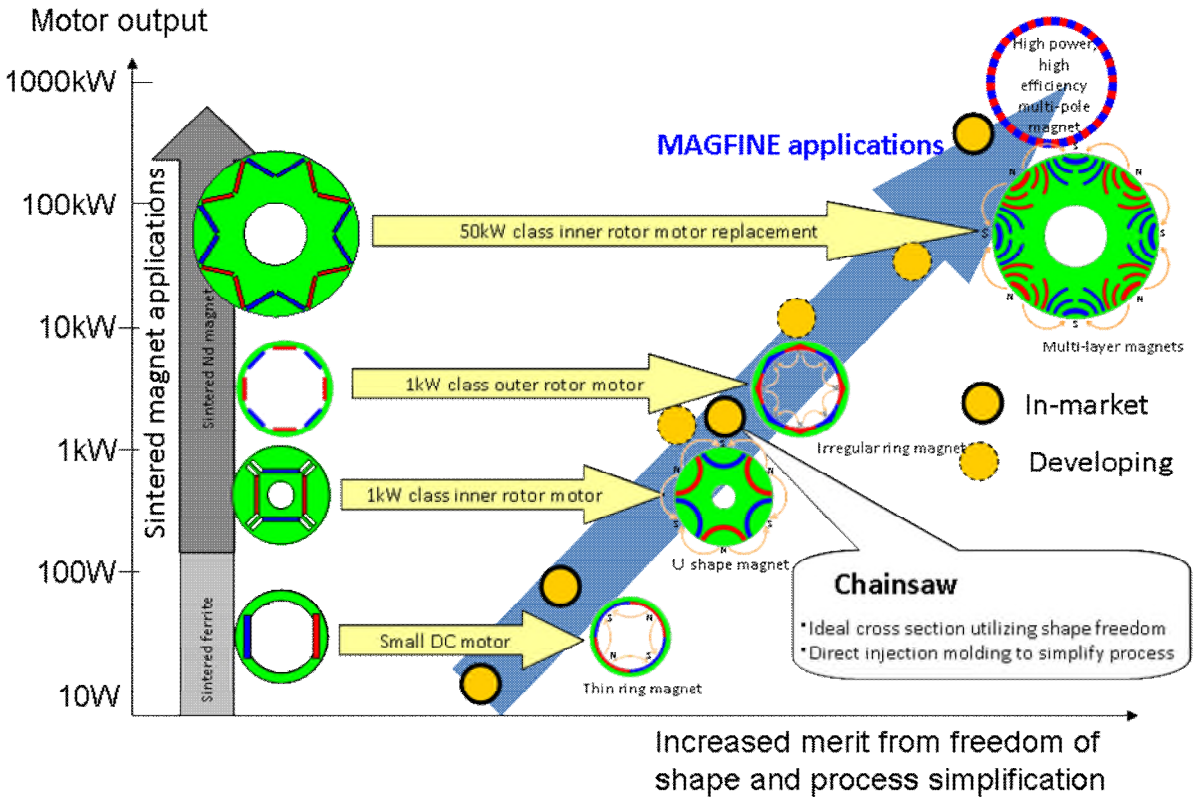

Figure 1. Application of MAGFINE to high output motors

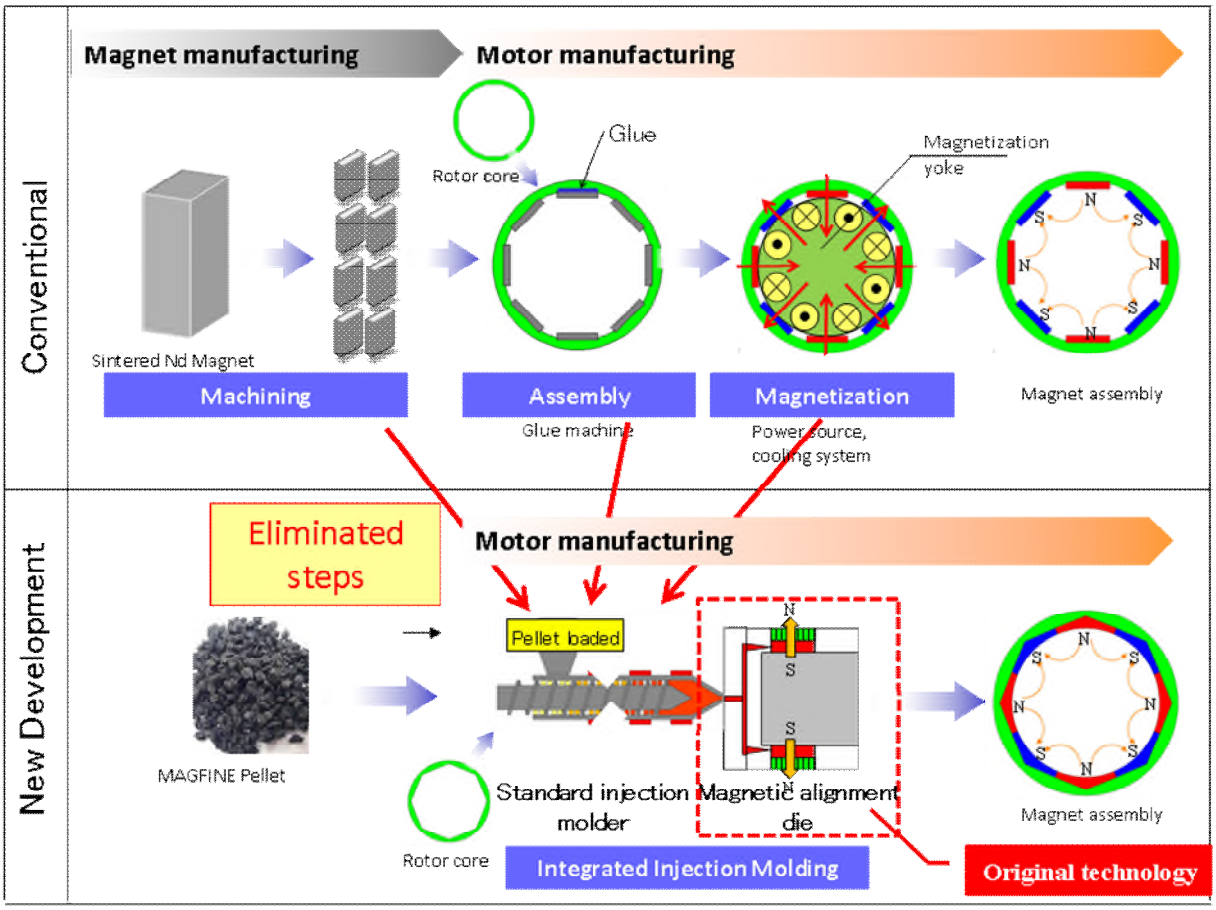

Figure 2. Process simplification by direct injection molding (established 2015)

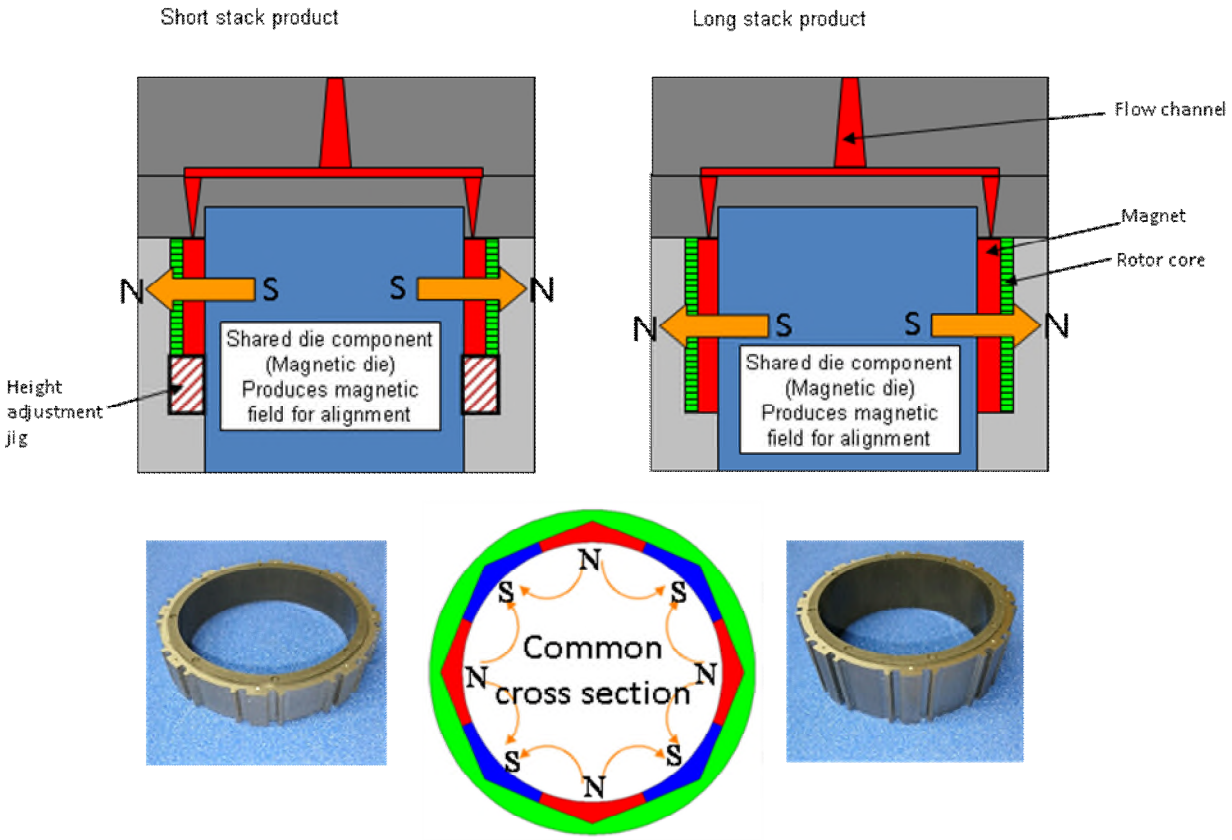

Figure 3. Direct Injection Magnet Manufacturing Process and Commonization