Retracing of BLDC Motor

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Abstract- ***This paper represents a review on recent developments in Brush Less Direct Current (BLDC) motors and study of various applications of BLDC motors and speed control. These motors are also called as electronically commutated motors (ECM), whereas these motors are containing permanent magnets as rotor. The main areas reviewed on permanent magnet, which are mainly neodymium magnets. They are very expensive and have to extract from very rare earth metals. A comprehensive study has been done on these permanent magnets in order to replace them to reduce the cost and improve the efficiency. As these BLDC motors have wide range of various advantages over normal DC motors and Ac motors. After a long study on these permanent magnets, hence proposed a new model of BLDC motors which are having IRON NITRITE magnets as permanent magnet. The proposed model has an advanced feature than previous model like efficiency, torque, power factor, speed and various parameters.***

Indexed Terms- BLDC, PMs, PMBL.

I. INTRODUCTION

In recent years, the BLDC motors are gaining more popularity. BLDC motors are extensively used in aerospace, automotive, robotic, industrial applications etc. BLDC motors have various advantages over other motors. Some of them are, better speed-torque characteristics, high efficiency, high dynamic performance, long operating life, noiseless operation etc. BLDC motors are one of the most efficient motors than any other type of motors [1]. They consume less power when compared to other motors, because all the motors (except BLDC) are having brushes and commutation process. There is a significant amount of power loss in the form of heat as a result of this commutation process. In these BLDC Motors there are no commutators for commutation [2]. In normal motors the rotor consists of windings whereas these BLDC motors consisting of permanent magnet as rotor. These normal motors having less torque when compared to BLDC motors. In BLDC motors a wide range of speed control is possible than any other motors. Compared with a DC motor, the BLDC motor uses an Electric commutator rather than a mechanical commutator, so it is more reliable than the DC motor. In a BLDC motor, Rotor magnets generate the rotors magnetic flux, so BLDC Motors achieve higher efficiency [2]. It has become possible Because of their superior performance in terms of high Efficiency, fast response, and weight, precise and accurate Control, high reliability, maintenance free operation, Brushless construction and reduced size, Torque to motor Size ratio is high, Thermal overload & under load protection Is provided [2]. Because of their higher performance; they perform high-Resolution control and minimize control loop delays. These Efficient controls make it possible to reduce torque ripples and harmonics and to improve dynamic behavior in all speed Ranges. The motor design has optimized due to lower Vibrations and lower power losses such as harmonic Losses in the rotor. Smooth waveforms allow an Optimization of power elements and input filters. Overall, these improvements result in a reduction of system cost and Better reliability. Switching electric machines from ordinary Digital control to microcontroller significantly improves Operating efficiency, saving energy while allowing the use of Smaller motors.

II. BLOCK DIAGRAM OF THE CONTROL SYSTEM

The block diagram of BLDC drive system is shown in Figure 1. It consists of a three-phase inverter, position Sensors, signal conditioner and a digital controller. The Inverter along with the position sensor arrangement is Functionally analogous to the commutator of a dc motor [3]. The commutation of a BLDC motor is controlled Electronically. The stator windings should be energized in a Sequence in order to rotate the motor. Rotor position should Be known in

order to switch the winding in sequence. A Permanent magnet brushless dc motor incorporates some Means of detecting the rotor position.

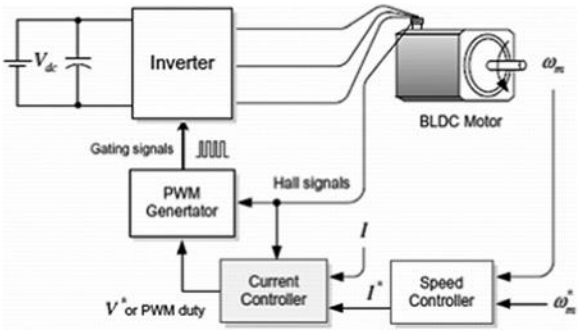

Fig 1: Block Diagram of BLDC Drive System

2.1 Use of Permanent Magnets

The use of permanent magnets (PMs) instead of electromagnetic excitation in electrical machines has a number of benefits, including no excitation losses and a simpler design. Construction, increased performance, and a dynamic environment, high torque or power per unit volume, and high efficiency in electrical devices, PM excitation was used. PM excitation in electrical machines was first used in the early 1800s, but due to low quality of PM materials, it was not widely adopted. In the year 1932, Alnico's discovery resurrected the use of PM excitation. However, it has been limited to small and simple systems [4]. Dc commutator machines with fractional horse strength Due to their rugged construction, squirrel cage induction motors were the most common electric motors in the twentieth century. Advancements in power electronics and telecommunications More capabilities have been applied to these by digital signal processors. Motor drives in order to increase their use in the industrial sector Constructions. In comparison to synchronous motors, squirrel cage induction 5 motors have a lower power factor and reliability. Synchronous, on the other hand, there are some drawbacks to motors and dc commutator motors, for example. Due to the use of, such as speed, noise problems, wear, and EMI Brushes and Commutators Due to these issues, permanent magnet brushless or commutator less synchronous motors with PM have been developed. As a result, permanent magnet brushless (PMBL) motors can be classified as a three-phase synchronous motor with permanent magnets on the rotor. Brush gear and electric commutator Transmutation Electronic switches are used to do this. Synchronized current to the windings of the motor place of the rotor. Alnico magnets, among the available PM materials, may have flux densities comparable to soft magnetic irons, but they are easily demagnetized due to lower coercive force values than ceramic magnets. Ceramic magnets are costeffective, but their maximum energy density product is limited due to lower retentive values [4]. Rare earth and samarium cobalt alloys have Relatively good magnetic properties, but they are Expensive. Other than polymer bonded rare earth magnets, for example, ferrite and cobalt based metallic magnets are Physically hard and brittle. Therefore, selection of the Particular PM material is application specific; however, Neodymium-Iron-Boron (Nd-Fe-B) rare earth magnets are More in demand because they provide the highest energy Density and higher residual flux density than others Due to the availability of high energy density and cost efficient rare earth PM materials like Samarium Cobalt, the popularity of PMBL motors is growing by the day.(Sm-Co) and Nd-Fe-B, which improve the efficiency of (Sm-Co) and (NdFe-B)PMBLDCM reduces the size and losses in these systems. The use of PMBL motors in a variety of domestic, commercial, and industrial applications has become possible thanks to advances in geometries and design developments. The apps PMBL machines are ideal for a variety of applications. Due to their power and medium-sized industrial drives Excellent dynamic capability, low losses, and high-performance Ratio of torque to Neodymium weight.

There are different magnets used in BLDC motor,

2.1.1 Neodymium Magnets

Neodymium is a chemical element that was discovered in 1885. This element (atomic number 60) has a silvery-white metallic color and belongs to the group of lanthanides, which is a subgroup of rare earth elements in the periodic table and rapidly oxidizes in air. Lanthanides play important roles in new technological developments, such as wind turbines, electronic hybrid vehicles, and in the defense industry. Neodymium-iron-boron magnets were developed by General Motors and Hitachi in the 1980s. Because it provides high magnetic force even in lesser amounts, it has been increasingly given a more prominent role in the manufacture of strong permanent magnets made

up of rare earth elements. In the field of information technology, neodymium magnets are particularly used in hard disc drives, mobile phones, video and audio systems of television [1]. Neodymium magnets are also commonly used in magnetic separators, filters, ionizers, in production of on off buttons, safety sector and security systems. Grease filter producers use neodymium magnets in metal separators to more effectively filter out iron powder in oil. Additionally, they are beneficial in covering machines, cars with awning and in the production of magnetic tool belts. They are also used in jewelry clips, identification badges and in the production of baby strollers that are attached to carriers via magnets. Neodymium magnets have push pull forces and have been used as a motion-generating device in orthodontic treatments; molar distillation, and palatal expansion. The amount of neodymium magnets used in all these areas has risen from 1 ton to 60.000 tons between 1983 and 2007. Since 1990, China has been predominant in the mining of rare earth elements. The mining of rare elements has various environmental impacts because of the low concentration of these substances; therefore, many countries have stopped the mining of rare elements and almost all countries depend on imports from China. In nature, neodymium does not exist in metallic or in mixed forms with other lanthanides but is refined for general use and has been mined in the USA, Brazil, India, Australia, Sri Lanka, and predominantly in China. Neodymium magnets are the strongest, the most important and commonly used permanent magnets at present. Based on different manufacturing process, it is divided into sintered NdFeB magnets and bonded neodymium magnets. Sintered NdFeB magnets are stronger than bonded NdFeB magnets. The grade of sintered NdFeB magnets is named as N35~N52, N30M~N50M, N30H~N48H, N30SH~N45SH, N28UH~N40UH, N28EH~N38EH and N28AH~N35AH.Under the temperature of 80°C, N52 magnets are the strongest permanent magnet material. Customers or users can order the most suitable NdFeB magnets from us according to their actual needs and application [4].

2.1.2 Iron Nitrate Magnets

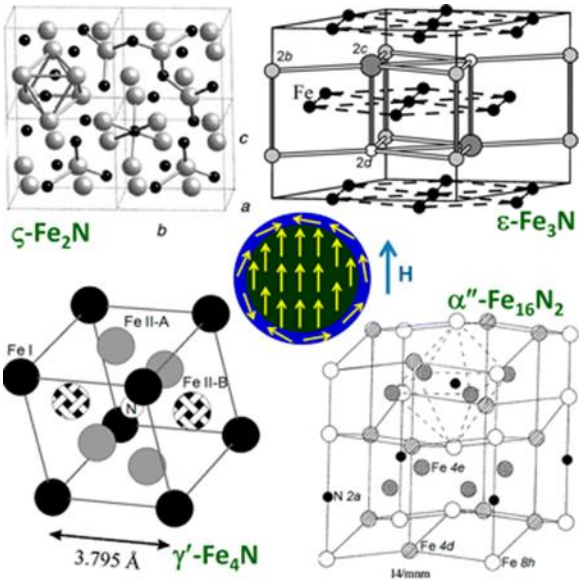

Fig 2: Iron Nitrate Magnets

First of all, the Iron Nitride is more powerful than Neodymium magnet (Neodymium magnet). The costs of Nitrogen and Iron are very low compared to rare earth magnets. They can be used in almost all areas where neodymium magnets are used [5]. A very strong permanent magnet can be created using iron and nitrogen instead of any rare earth inputs, such as neodymium. The theoretical magnetic energy product for this iron nitride (Fe16N2) magnet is 130 mega gauss oersted's, which is more than twice the maximum reported magnet energy product for a rare-earth neodymium magnet [6]. The process is environmentally friendly and compatible with mass production techniques and has applications in electric motors, wind turbines, and electronics [7].

2.2 Proposed System

Iron Nitride, Alternative to Rare Earth Magnets (i.e, neodymium magnets) A process has been designed to create a very strong permanent magnet that does not require any rare earth inputs, such as neodymium. The theoretical magnetic energy product for this iron nitride (Fe16N2) magnet is 130 mega gauss oersted's, which is more than twice the maximum reported magnet energy product for a rare-earth neodymium magnet.

2.3 Features & Benefits of Iron Nitride Permanent magnets

- Do not require any rare earth inputs; uses common and low-cost iron and nitrogen inputs.
- Theoretical limit of its magnetic properties is more than twice the maximum reported magnetic energy product for a rare earth magnet.
- Environmentally friendly.
- Compatible with mass production techniques.
- Many high-tech applications including electric motors, wind turbines and electronics.

2.3 Application of BLDC Motors

- PMBLDC motors find applications in diverse fields such as Domestic appliances, automobiles, transportation, Aerospace equipment, power tools, toys, vision and sound
- Equipment and healthcare equipment ranging from Microwatt to megawatts.
- Advanced control algorithms and Ultra-fast processors have made PMBLDC motors suitable for position control in machine tools, robotics and high Precision servos, speed control and torque control in Various industrial drives and process control applications.
- With the advancement in power electronics, it is possible
- To design PMBL generators for power generation onboard Ships, aircraft, hybrid electric cars and buses while Providing reduced generator weight, size and a high Payload capacity for the complete vehicle.

CONCLUSION

Due to these various advantages of iron nitrate magnets, neodymium magnets or any other rare earth metal magnets should be replaced by these iron nitrate magnets, can reduce cost, increases efficiency and having various advantages.

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