Primary Analysis of Development Strategy for Permanent Magnet of MRI in China

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Abstract: The development and challenge of permanent magnet MRI in China was analyzed with the structure of permanent magnet MRI from magnetism view. Three advices on promoting the development of Permanent Magnet MRI industry in China are put forward.

Key words: permanent magnet MRI; magnet; permanent magnet organization; well logging

1 Development Course and Challenge of Permanent Magnet MRI in China

MRI is the mirror of the perfect combination of foundational science, technological science and engineering science in the last century. Since 1983, the first batch of MRI products were put in hospitals. It has contributed to millions of patients, therefore, it is also a mirror of benefiting human beings.

As far as the high-tech product was concerned, the relevant department in China paid highly attention to MRI. In 1984, MRI industry supported by national commission of science and technology, commission of development and reform, commission of economy, ministry of health, ministry of finance and Chinese academy of Science was established. Domestic hospitals were equipped by MRI product after its quality judgement and subsequent production in 1989. During 20-year development, many corporations such as Anke, Dongruan, Xingaoyi, Wandong manufacture MRI in a large scale at present in China.

60% Thulium resource all over the world is reserved in China. China is one of the countries that invented the 3rd generation of the permanent magnet. The output of the Thulium permanent magnet takes the first place in world. Permanent Magnet MRI was regarded as the pivot at the beginning of Chinese MRI industry in this background. Our MRI industry develops quickly due to this policy and many patients benefit from MRI as early as possible.

Nowadays, permanent magnet MRI still exists with the superconductive MRI in which it can be realized "open" quickly, maintained simply and it can meets the requirement of clinic practice.

However, from the perspective of the MRI development scale, product quality and the efficient utilization of Thulium permanent magnet resource in china, there is still a long way to go. Those who are in charge of Chinese Permanent Magnet MRI and Permanent Magnet application still face a challenging future.

First of all, the large demand of MRI in the future Chinese market and the fact that the human resource and substance resource serve the manufacture of Permanent Magnet MRI magnet system are all in china decides that the oversea corporations master the advanced MRI technology come into china, establishing research center, founding the factory, purchasing shares of Chinese counterparts. They take over Chinese MRI industry and control Chinese MRI industry by taking advantage of capital, technology and management.

From the point of Chinese economy and social development and the resource reservation, those work for our MRI industry should recapture the leading position of MRI development because the large Permanent Magnet resource and most of the artificers of magnet research, development and manufacturing are in China. What should we do if we want to make this destination come true at present?

Secondly, though it is abundance in Thulium

Permanent Magnet in china, Thulium is not reproducible resources as petroleum. Currently, NbFeB materials industry is under the pressure of low profit. Government control the exploitation of mine every year in order to protect the resource.Therefore, how to make full use of the permanent Magnet materials by science and technology method is the thing on list. Another problem is how to transform the resource advantages into economical advantages.

2 Permanent Magnet MRI

Permanent magnet MRI is the carrier which can transform the resource advantages into economical advantages of Thulium materials. Thulium Permanent Magnet can be applied on many areas such as electrical machine, IT, automobile, electrical appliance and so on. But there is a little demand (level g, 10g, 100g) in quantity and rigid requirement in quality of permanent materials in those field.

For example, the NbFeB applied on motor can work only under 150-180℃. The slice of Magnet applied on sound-circle motor requires high uniformity of property. As for Permanent Magnet MRI, it will need 2-5 t permanent Magnet materials in every body imaging magnet and will not crab at the materials properties. The transform efficiency from resource into profit is considerable. Therefore, Permanent Magnet MRI is the best carrier that can transform the resource advantages into economical advantages.

3 Realization of Intermediate Field Intensity of Permanent Magnet MRI

The working field intensity of present clinic superconductive MRI and clinic permanent Magnet MRI are 1.5T and 0.35T respectively. The profile is not quite different for 0.35T magnet manufactured by domestic industry: its weight is a little more than 20 t, and its net working space height is 0.4-0.42 m.

The results from researches show that we can increase the working magnetic field intensity of Permanent Magnet MRI magnet from 0.35T to 0.62T in the premise that we can keep the 'open', gross weight , figure size and net working space height of 0.35T permanent magnet MRI unchanged by using sintered NbFeB which largest amass of magnetic energy is $42*10^6$ Gauss Ausita.

The working magnetic field is vertical magnetic field. Its efficiency of RF loop is 40% higher than the one of RF loop from superconductivity magnet. Therefore, the property of Permanent Magnet MRI with 0.62T may reach the level of superconductive magnet with 0.868T.

If we call MRI with 1.5-3.0T as high field MRI, then Permanent Magnet MRI with 0.62T is the intermediate field. Its properties are better than current MRI and reach the low level of superconductive MRI.

The news from HITACHI was said: they developed 0.4T MRI successfully and its field intensity is 0.5T, higher than domestic one. But the price is 7 million RMB, 40% higher than the price of the current MRI. Whatever the deal price is, we are sure that the value of Permanent Magnet materials is improved. So the value of permanent Magnet materials will be improved again without adding its weight after the appearance of 0.62T MRI.

Intermediate permanent Magnet MRI is the carrier of the value transform of Thulium permanent Magnet due to its large demand and the big vacancy in market.

4 Trial Production Generality of Imaging Magnet From 0.62T Permanent Magnet Body

Accordingly, we will produce imaging magnet with 0.62T working magnetic field intensity of Permanent Magnet MRI magnet in the premise that can keep the 'open', gross weight, figure size and net working space height of the 0.35T permanent magnet MRI unchanged by using sinter NbFeB whose largest amass of magnetic energy is $42*10^6$ Gauss Ausita.

First of all, shown as Fig.1, we designed a magnet according to the current one used home and abroad, called contrapose magnet.

The curve in the right hand of the picture shows the distribution of the middle of the working region in the magnet in the range of 0.3m, along X axis, Y axis and Z axis. The average magnetic field intensity is 0.375T.

Now we keep all the dimension unchanged ,that is Polar diameter, Magnet buttress, the height of Magnet buttress, the distance from polar iron to iron and the distance from polar skirt border to skirt border ,in addition, we should also keep the material of