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Analysis of New Materials and Production Process of Bimetallic Steel Bearing Shell

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ABSTRACT. *One of the most important parts in the internal combustion engine is the bearing shell, whose structure and performance have a great influence on the structural design and performance of the internal combustion engine. At the same time, it also affects the service life of the internal combustion engine. Therefore, the bearing shell, one of the important parts of the internal combustion engine, also has higher requirements. It must not only have good wear resistance and high strength fatigue ability, but also have good corrosion resistance, support bite, compliance, mosaic, and sufficient environmental performance. This paper mainly explores the new materials of aluminum-steel bimetallic bearing shell and analyzes the selection of their production process.*

KEYWORDS: *Metal bearing shell; Aluminum material; Production process*

1. Introduction

With the development of social economy, the transportation industry has also developed rapidly, so that the engine is being strengthened in the direction of low consumption, high speed, high power, miniaturization, high supercharging and light weight. At the same time, with the continuous improvement of people's requirements for their own health, the public's awareness of environmental protection is increasing, so they hope that the engine will be environmental and that the car will be pollution-free. Therefore, exploring the environmental protection and high performance of bearing materials has become the leading direction of research.

2. Type of Bearing Materials

At present, the steel bimetallic bearing shell used in various countries in the world is mainly composed of steel back + anti-friction alloy layer + plating, and steel back + anti-friction alloy layer. According to the type of anti-friction alloy layer, it can be divided into copper-based, lead-based, and aluminum-based. For modern engine steel bimetal bearing shell, the fatigue strength of lead-based or tin-based materials is not sufficient, and these materials are only suitable for a few occasions. Therefore, the main research direction of people is aluminum-based materials or copper-based materials. Copper-based materials usually contain a high degree of lead, and when copper-based steel bimetal bearings are used in engines, they need to be plated with a lead-based alloy with a thickness of 15tm to 25tm, but lead is a toxic metal. During the processing of lead, it is harmful to the human body and will cause pollution to the environment [1]. In addition, the use of lead-containing copper-based steel bimetallic bearing shell will contaminate the lubricating oil, which makes it difficult to effectively solve the problem of disposal of the engine during maintenance or scrap. The aluminum-based steel bimetal bearing material has low lead, and other metal elements can be added to the aluminum alloy to replace the function of the lead element. At the same time, the aluminum-based bearing can be either coated or uncoated, which will not affect its use effect. For the bearing without coating, the bearing is completed after processing; while the bearing of the coating is processed, its size will be affected to a certain extent, and it will be affected by the thickness of the middle plating during the plating operation. As a result, the thickness is superimposed, and the thickness of the bearing shell is larger than that of organic processing. Therefore, the non-plated bearing pad can reduce the runout of the radial clearance, effectively reduce the noise and extendi the life of the engine. And the uncoated bearing shell will not have the pollution and treatment problems of the plating solution, so they have strong environmental protection performance. The uncoated aluminum-based steel materials of bimetallic bearing shell are increasingly popular for internal combustion engines. Of course, copper-based materials are still important bearing bushing materials, and most of them are used in engines with heavy loads, such as racing cars and diesel locomotives.

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3. Production Process of New Materials of Bimetallic Steel Bearing Shell

At present, there are two kinds of production processes in the production of bearing materials: powder metallurgy sintering process, casting process and composite rolling process. The powder metallurgy sintering method is usually used in the production of copper lead bearing materials, but it is still in the stage of trial research. The casting and composite rolling method is usually suitable for the production of aluminum-based steel bimetal bearing materials. However, the traditional casting and composite rolling process is complex and inefficient, and it has a great impact on the metallographic structure of the alloy if there is a mistake in the operation of alloy metallographic structure, so it is necessary to introduce a new production process of bearing material.

3.1 Casting and Rolling Method

Casting and rolling method is a kind of rapid cooling production process. Alloy is used for casting between two water-cooled metal rolls. When alloy enters into the roll gap, the part contacting the metal first solidifies rapidly, and passes through the roll gap quickly to achieve the effect of rapid cooling and solidification, and finally leaves the mill through casting and rolling [2]. In addition, the use of casting and rolling method can change the alloy into a fine grain microstructure in about one second when the alloy is cooled from liquid state to below the curing temperature, which can not be obtained by the traditional casting method. In addition, the casting and rolling method can realize continuous casting. After casting and rolling, the alloy can adhere to the steel back at 250 ℃ to 450 ℃. The fine tin will make the alloy directly adhere to the steel back without intermediate layer (nickel or pure aluminum) under high temperature. At the same time, with the help of high temperature, the thickness of steel layer does not decrease obviously after alloy adhesion, so the forming effect of bimetal strip is increased. At last, the adhesive bimetal strip can be used without annealing, but in the traditional casting method, the adhesion between the steel back and the alloy can only be strengthened in the annealed state.

3.2 Rolling Compound Method of Liquid Phase to Solid Phase

The principle of rolling compound method is similar to casting and rolling method. It is a new production method of steel double bearing shell which combines casting and rolling compound method. It has the advantages of casting and rolling method and uses less production equipment, lower cost and higher efficiency. Rolling is to make the alloy layer more compact, but at the same time it has a great influence on the properties of products. The densification of the alloy layer is directly related to the performance of the material. If the densification of the alloy layer is low, its bearing capacity and fatigue strength will also be reduced. Even the soft metal coating on the inner surface of the bearing bush can not be coated because of the low densification, resulting in the waste of the product. Therefore, a re-rolling should be carried out after the primary rolling, which is mainly to further improve the compactness of the alloy layer and make the bimetal strip composite with the final dimension and dimensional tolerance [3]. The increase of rolling amount can effectively improve the density of the alloy layer, but the alloy layer will also become brittle due to work hardening, so that the internal stress appears uneven, and the fatigue resistance of the material is reduced. Therefore, in the process of re-rolling, it is necessary to pay attention to the size of deformation to ensure that the alloy layer density and to ensure that it has good performance.

3.3 Explosion Method

In the face of extra-large thick-walled aluminum-based steel bimetallic bushing materials, rolling methods cannot be used to produce them on general equipment. Therefore, Russia has developed a new production process method named as the explosion method. The explosion method connects the aluminum alloy and the steel back through the power of the explosion to obtain the bearing shell blank. The bimetal plate double-layer obtained by the explosive method has a connection strength one time higher than that of the bimetal plate obtained by the common rolling method, and its fatigue strength has also been doubled. Through the study of metallography, we find that the existing grains are fragmented and formed into fine pieces. The fragmentary structure has a significant effect on improving the strength of the metal. This is a stable structure that is far from equilibrium through plastic deformation. Generally, the working life of aluminum-based steel bimetallic bearing

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material is longer than that of lead bronze bearing bush.

4. Conclusion

It can be learned from above that, because the development of ketone-based bearing material will be limited due to environmental factors, aluminum-based bearing material is the most promising bearing material. The choice of the new materials of aluminum-based bearing in production process is also different from that in traditional production process, and its production efficiency and production cost have been greatly improved.

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