Study on diagonal hammer of three kind metals composite casting with block protecting handle

Hui Liu [1a], Shou fan Rong[2],Yan he Wu[1],Peng hui Yang[1],Xiu lan Duan[1],Yong chang Zhu[1]

School of Materials Science and Engineering, Jiamusi University,Jiamusi,154007,China

Abstract: Hammer crusher is widely used in cement, ceramic, mining and electricityother industries, hammer head is one of important parts in crusher, its abrasion performance directly affects the service life of hammer crusher and economic cost. According to bimetalcomposite hammer head is often appear "Hammer handle wear and tear","Composite difficult" and the set of casting alloy block hammer head set piece of "come off" phenomenon, which design a set piece type bimetal composite casting straight diagonal hammer, make full use of high chromium cast iron wear resistance and the toughness of low alloy steel.Design a protect block structure reasonably that solve the hammer when the actual production of composite interface is difficult to control and "the problem of hammer head wear"for use.Solve the problem of hammer head wear actively, achieve "energy saving, emission reduction and environmental protection".

Keywords: Wear and tear; Straight bevel hammer; Hammer handle wear and tear; Dissimilar metal composite

1 Introduction

Hammer crusher iswidely used to cement, metallurgy, mining, coal, building materials, transportation and other industries, mining of the ore is high speed rotating hammer broken into grinding material, the workload is very heavy.Hammer crusher is one of the shortest life and the biggest parts of consumption. And Hammer head basically has single material hammer head, cast in alloy block hammer head, doubleliquid metal composite hammer head. High manganese steel was made earlier crusher hammers and common one kind of material, but some broken material impact is not strong,the work hardening of high manganese steel can't display,high manganese steel wear fast, short service life and so on problems, and Single material of hammer head can't meet the needs of high toughness and high wear resistance. Cast in alloy block hammer head often set piece of "come off", Bimetal composite hammer head is often appear "Hammer handle wear and tear" and "Composite difficult" phenomenon.

According to the above problems, this paper designs a with a piece of straight bevel type hammer handle, with good abrasion resistance of high carbon high chromium steel manufacturing

handle piece, hammer end work part adopts high wear resistance of high chromium cast iron, hammer handle part adopts good toughness of low alloy steel. Give full play to the material and cast-in superiority, solve the problem of hammer head production and application in [1].

2 Testing materials and methods

2.1 Determine the structure

This paper studies the with a piece of straight bevel type hammer handle, It contains the hammer side and with the hammer handle, hammer side is equipped with right angle trapezoid structure to protect the handle. To protect the handle (as shown in figure 1a)with good abrasion resistance of high carbon high chromium steel and cast in the hammer handle the wear parts.hammer handle (as shown in figure 1b) is good toughness of low alloy steel material, and the hammer end (as shown in figure 1c) is to use high wear resistance of high chromium cast iron material. The study of the hammer head of simple structure, not only solved the "handle" phenomenon, but also solves the caused by the external environment and the level of workers is not enough "composite difficulty" problem. And without affecting the original under the premise of use function, greatly extend the service life of the whole, reduce the maintenance cost and use cost of the enterprise. Straight bevel hammer structure as shown in figure 2 [2].

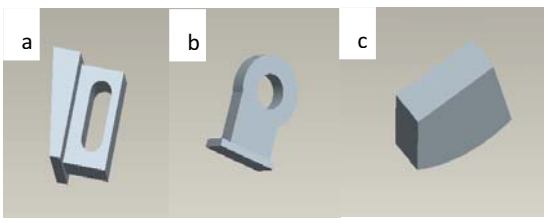


Figure 1protect the handle schematic block type straight diagonal hammer decomposition

a) protect the handle piece b) hammer handle c) side

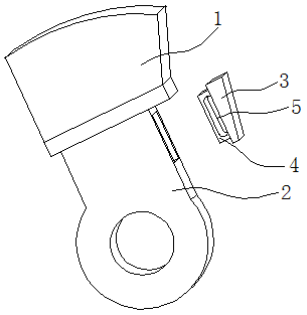


Figure 2 protect the handle type straight diagonal hammer piece of structure

1）Side 2）Hammer handle 3）Protect the handle piece 4）Jack 5）Waist type hole

2.2 Determine the chemical composition of composite materials

In order to make protect the handle piece, side, hammer handle to achieve their ideal abrasion resistance and toughness, in this article, use the high carbon high chromium steel armor handle with better abrasion resistance, and hammer end is high abrasion resistance of high chromium cast iron, the hammer handle is toughness good low alloy steel. According to the needs of the effect of alloy elements and the performance of the belt can be determined to protect the handle of the chemical composition of each place straight diagonal hammer as shown in table 1.

Table 1 chemical composition table (wt %)

Material	C	Cr	Mn	Mo	Si
High chromium cast iron	2.9 ~ 3.0	22 ~ 24	1.5 ~ 1.8	0.4	≤0.6
Low alloy steel	0.32 ~ 0.4	0.6 ~ 0.8	0.6 ~ 0.7	--	0.4
High carbon high chromium steel	1.0 ~ 1.2	8 ~ 10	1.2 ~ 1.5	0.2	0.4

2.3 Heat treatment process

This study chooses the wind quenching heat treatment process, the austenitizing temperature heated to 1020℃,then use the air-filled.Will tempering temperature heated to 230℃, and continue to air cooling.Research on heat treatment process to observe straight diagonal hammer's the law of the performance, thus

ensuring a good comprehensive mechanical properties. Heat treatment process curve is shown in figure 3[3].

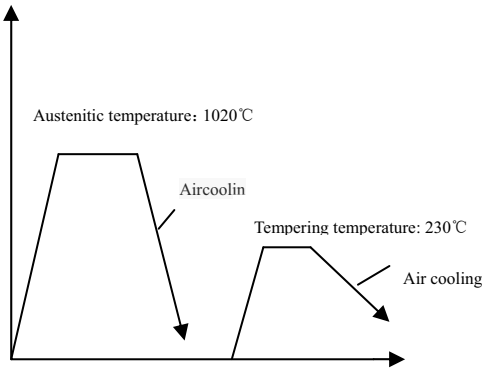


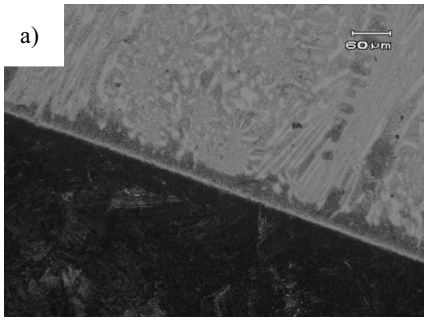
Figure 3 heat treatment process curve

2.4 Compound technology

First of all, protect the handle piece of the high carbon high chromium material heated to 300℃, put in the cavity and mould assembling, then poured into the low alloy steel liquid, At this point, the liquid steel temperature is about 1580 ℃, after a layer of solidified shell in low alloy steel, pouring into around 1550℃ high chromium cast iron liquid, through the heat capacity of high chromium cast iron melting low alloy steel solidification. Finally, to obtain the ideal metallurgical bonding[4].

3 Results of the study

3.1 Microstructure observation and analysis



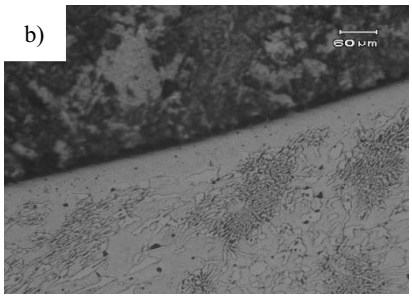


Figure 4 three types metal composite microstructure

a) high chromium cast iron with low alloy steel

b) low alloy steel with high carbon high chromium steel

Through the observation of the microstructure, after heat treatment, low alloy steel group is composed of needle martensite and retained austenite. Figure in the dark is needle martensite, bright is residual austenite.

After heat treatment, high carbon high chromium steel constitution as the net eutectic carbide, distribution at the grain boundary and secondary carbide particles evenly distributed in bainite, martensite and retained austenite matrix. In A1 above a certain temperature, of the high carbon high chromium steel constitution convert into austenite, and in the matrix alloy elements diffuse more fully, more uniformity. After cooling, the eutectic carbide network disconnect, most constitution dissolve into matrix; Chromium in the form of secondary carbide precipitation. Therefore, in the matrix, a large number of distribution in the granular secondary carbides[5].

After heat treatment, the organization of high chromium cast iron $(Fe, Cr)_7C_3$ carbide, isolated distribution in continuous martensitic matrix. On the matrix, distribute the hexagonal rods and plate strip type M_7C_3 carbide, thus greatly reduced the continuity of matrix, reducing the degree of damage to the substrate, to improve toughness [6].

3.2 Composite interface bonding zone microstructure characteristics

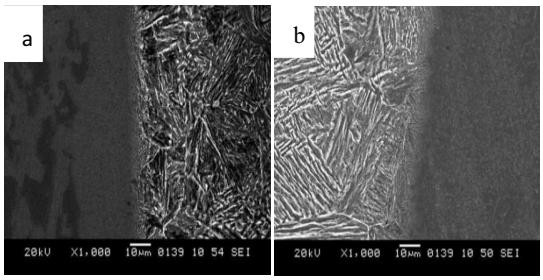


Figure 5three types metal composite interface organization characteristics

a) high chromium cast iron/low alloy steel low alloy steel

b) low alloy steel/high carbon high chromium steel

Figure 5(a) liquid-liquid composite icrostructure characteristics.Composite interface can be seen in the metallographic photos showing a small serrated, appear the phenomenon of melting and mutual penetration. And composite interface no shock phenomenon, compact structure, achieve ideal metallurgical bonding state [7].

Figure 5 (b) solid-liquid composite micr-ostructure observation, In metallographic figure, you can see the interface without micro crack, blowhole and inclusions, etc..Formed a similar liquid-liquid double metal composite of straight line.So in the combination of fluid of low alloy steel with high carbon high chromium steel interface to achieve complete metallurgical bonding state[8].

3.3 Microhardness

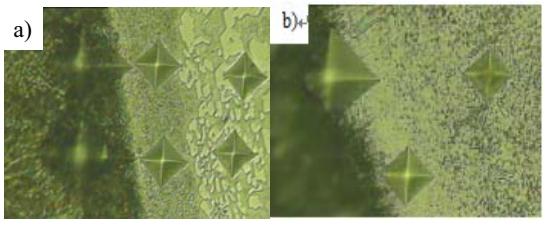


Figure 6 microhardness bimetallic interface bonding area

Through the analysis of the microhardness: If the interface has a good combination of area, the microhardness should gradient smooth transition, and measured the hardness of low alloy steel is about 350HV, solid interface combined with the hardness of about 510 HV, fluid interface in combination with the hardness of about 580 HV, the hardness of high carbon high chromium steel is about 750HV, the hardness of high chromium cast iron is 950HV.Obviously,the microhardness value is obvious gradient distribution.

4 Benefit analysis

In protecting the handle piece of crusher hammer straight Angle, the main technical indicators are the hardness of high chromium cast iron and low alloy steel, impact toughness and wear resistance and the impact toughness on bimetal hammer. After the wind quenching heat treatment, the hardness of high chromium cast iron is more than 62 HRC, impact toughness for 3~6 J/cm2; The hardness of low alloy steel is 180~250HB, impact toughness is greater than 70 J/cm2; To protect the handle piece of 55 HRC hardness above [9], impact toughness for 6~8 J/cm2.

Through installed test showed that protect the handle piece type straight diagonal hammer service life is 3 ~ 5 times of the high manganese steel, The cost of production is the single material of high manganese steel hammer 1.5 times, not only improves the production efficiency, increase the service life of hammer crusher hammer, and for the "energy conservation and emissions reduction, low carbon environmental protection" has made a great contribution. Extended life expectancy and the hammer head replacement cycle, reduce the working strength of workers, a working cycle will save the time for replacing hammer head many times, improve the production efficiency of crusher. To protect the handle piece type straight diagonal hammer schematic diagram and the real figure as shown in figure 7 [10].

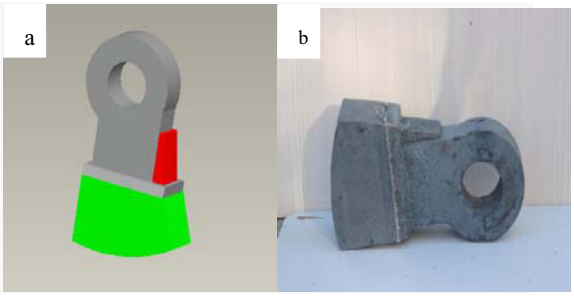


Figure 7 a) straight diagonal hammer handle piece of type b)Real figure

Conclusions

(1)This article can completely solve the set piece "come off" of casting in alloy block type hammer head, bimetal composite oblique hammer often appear "handle" and "complex difficulties" and so on.

(2)Using liquid-liquid composite casting echno-logy, the composite interface routine jagged state, can obtain complete metallurgical bonding of bime-tallic interface bonding area; Liquid-solid com-pound can achieve certain mechanical connec-tion and part of the metallurgical bonding.

(2)Through the wind quenching heat treatment process, under the conditions of equal protection of the handle to block the service life of straight bevel hammer, higher than the single material fierce steel hammer head high 3~5 times, abrasion resistance and toughness is improved obviously.

Acknowledgements

This work is by the national natural science foundation of China 51371090, jiamusi university entrepreneurial innovation project lzz2015-005, jiamusi university President fund xzyf2014-04 and xzyf2016-04.

References

1. Hanguang Fu.Metal casting ear-resistant materials research progress[J].China casting equipment and technology,2006.
2. Shoufan Rong,Zhang Yin, Jiwei Guo .Casting low djembe anti-wear ustenite steel excavator relieving material research[J].casting 2007.
3. Enze Liu,Shucheng Sun.Effects of heat treatmenton microstructure and perfor -mance of high chromium cast iron [J].The hot working processes,2008
4. Benkui Gong,Gu Hua,Yu Hai.Hammer crush -er hammer head[J].Sintered pellets,2006.
5. Dadong Shen,Baoshi Jin,Enlu Wang.Low alloy Mr Berlusconi ladle cast high chrom -ium cast iron hammer head devel -opment [J]. Journal of thermal proc -essing, 2003,
6. Wang Chao,Hongxiao Cheng.Xiangdong Wang.The high chromium cast iron, cast steel hammer head cast in [J].The casting equipment research,2004.
7. Zhang jun, zhenqing wu,Bowen Xiong.The development of the bimetal composite hammer and production [J].The hot working processes,2006.
8. Yaohui Liu,Haifeng Liu,Sirong Yu.Solid-liquid combined with double metal composite material interface research [J].Journal of mechanical engineering,2000
9. Bleck,Wolfgang,Kriangyut Phiu-on,Christo -ph.Hot Workability of as-Cast High Mang -anese-High Carbon Steels[J].Steel Research International, 2007,
10. Lixin Shi.Hammer crusher hammer head repair [J].Cement,2006.