

# Laser cladding technology in the repair of shearer picks

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*Received 1 December 2014, www.cmnt.lv*

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## Abstract

Xinjiang is rich in coal mineral resources, and the consumption of machineries in mines wear is quite great. In order to improve the wear of mining shearer picks, laser cladding technology have been used in the repair of worn shearer in this paper, and the result is very satisfactory. The conclusion provides some reference and guidance for similar problems of repair, and its application prospects are extensive.

*Keywords:* shearer picks, wear, laser cladding, repair

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## 1 Introduction

Xinjiang is located in China's northwest, where possesses the most abundant coal resources of the whole of China. The expected coal storage in Xinjiang is about 2.19 trillion tons, accounting for 40% of Chinese total reserves. In 2014, China approved the construction plan of large coal bases in Xinjiang. The large- coal bases in Xinjiang, which is the fourteenth national large coal bases, is an important base to develop the coal productive forces in west part of China. In order to promote the coal resource advantages into economic advantages and accelerate economic and social development in Xinjiang, a principle of high starting point, high-level, high-efficient construction of large coal bases in Xinjiang with a way of sustainable resource development, and sustainable ecological environment development was agreed. Although rich coal resources has brought rapid economic development to Xinjiang, the waste in coal mining enterprises is still shocking, especially the high frequency use and easily damaged components of large mining machinery – shearer picks.

Shearer picks are the parts that mounted on the drums and cut coal directly in the coal seam. When the drums rotating, shearer picks rub against the seam directly. Therefore, the friction and wear is the main failure mode of picks. When there are waste rocks and other hard materials in a mine seam, the shearer picks will wear drastically, at the same time, the temperature can reach to 600 ~ 800 °C by friction, and the wear of the shearer picks will speed up. Picks suffer high stress, shear stress and shock loads when cutting coal and rock. If the rock is high hardness (up to HV900 ~ 1 100), it will cause overload of the shearer picks and fracture directly. The consumption of picks in coal mining is staggering. Learned from the relevant professional and technical personnel in Dahuangshan mine, Jinta Industrial Co., Ltd.

Fukang City, more than 95% of the total shearer picks failure was wear failure in Dahuangshan coal mine in Xinjiang. The situation in other mines in Xinjiang is similar, and the wear failure of shearer picks also accounted for about 95% of the total failure.

## 2 Laser cladding technique

Laser cladding technique is a surface modification technology that clad a kind of metal on the other metal material surface to improve its wear resistance, corrosion resistance and other properties. Laser cladding technique combines laser technology, computer technology, digital technology, sensor technology and materials processing technology. It is a new multi-discipline-crossing edge subject and emerging advanced manufacturing technology. The technology combines the rapid prototyping techniques and laser cladding surface hardening technology. Molten pool is formed on the metal substrate by high-energy laser beam, then metal powder which is delivered to the molten pool by entrainment means or a powder spray nozzle preset, or the coating preset on the substrate in advance is melted, after rapid solidification, metallurgical bond with the substrate is formed. According to the parts of the computer aided design model, materials are accumulated through line by line, layer by layer, and three-dimensional near-net shape metal parts are directly formed. Laser cladding system is composed by the following four parts, a computer, powder delivery system, and laser and CNC table.

Laser cladding technique has the following process characteristics: 1. Due to the high energy density and fast heating speed of the laser, the heat effect of laser cladding on the substrate is very little, and the deformation caused by laser cladding is also small, thus scrap parts in the laser cladding procedure are thimbleful. 2. The matrix material can be diluted down to a lesser extent by

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controlling the laser input energy, thus ensuring the formation of metallurgical bonding with the cladding layer and the substrate under the premise, while maintaining the original excellent properties of the cladding material selected. 3. It has a wide range of applications, and almost all of the metal or ceramic materials can be laser cladding to any alloy theoretically. 4. through beam aiming, it is possible to process are as which is difficult to reach and the process can be automated easily. Because of these advantages mentioned above, laser cladding technology has been attracted increasing attentions been concerned in fields of the materials surface modification in recent 10 years.

Given the advantages of laser cladding technology, if the worn shearer picks are repaired by laser cladding technology, the cost is only 25% to 30% of the cost of new products, and energy and materials savings is more than 60% and 70% respectively.

### 3 Repair the worn shearer pick

The common materials of actual use of shearer picks, whether imported or domestic, the materials of shearer pick body are most steel, such as 42CrMo, 35CrMnSi. The shearer picks production standards of the heat treatment process of the coal industry require that the hardness of shearer pick blade is 40~45HRC, and impact toughness is not less than 49 J / cm<sup>2</sup>. In the production process, shearer pick material should meet or exceed the requirements specified mechanical properties by heat treatment.

Then a worn shearer pick of mine in Xinjiang was repaired in this paper. The material of the shearer pick is 42CrMo. The degree of wear is shown in Figure 1.



FIGURE 1 The worn shearer pick



FIGURE 2 Repairing by laser cladding technique

The IPG4000W fiber laser equipment and the KUKA robot equipment of Germany are used in the process. In view of shearer pick 42CrMo material, we

chose laser cladding powder Machinery Co., Ltd. Shandong more gold production of nickel-based self-fluxing alloy powder grades for the DJ-N1560~75. Repair process is shown in Figure 2.

### 4 The results of laser cladding repairing

Figure 3 shows the worn shearer pick after the laser cladding repairing. The worn shearer was repaired by laser cladding technique, and wear-resistant alloy coating layer which having a thickness of about 2.5mm was clad. After testing, the picks average micro hardness can reach to HV900, Rockwell hardness is HRC67, and the intensity is approximate to 1300MPa, far more than HRC40 picks coal industry regulations. Furthermore, toughness and fatigue strength has also been greatly improved, and the wear resistance and other mechanical properties of shearer picks is also greatly improving. The life of the shearer pick increased to 5 times through practice utilization.



FIGURE 3 The worn shearer pick after the laser cladding repaired

### 5 Conclusions

In this article, shearer picks, vulnerable parts used in Xinjiang coal mine machinery was repaired by laser cladding forming technology, which is the most cutting-edge. Technology in the manufacture field, the strength, hardness, toughness and fatigue strength of the repaired shearer pick were improved significantly, and the life of the shearer pick was extended greatly. The technology has high applicability in the field of mining machinery. It can not only reduce the costs of coal mining enterprises, but also reduce the consumption of resource and energy, and the pollution of the environment. Since huge economic benefits are accompanied, laser cladding forming technology will have very extensive application in the coal business.

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