

# 北京金煤创业科技股份有限公司

## Beijing JinMei Entrepreneur Co., Ltd.

金属基陶瓷复合铸造技术

### **MMC - Metal matrix ceramic insert casting technology**

installation and layout of Ceramic core

Molding / Smelting / pouring

Heat treatment / Inspection

Hardness / metallography

pouring and riser cutting

Cleaning/grinding/machining

Packing / Use effect

## 公司简介

## Company profile

北京金煤创业科技股份有限公司于2006年成立，2016年改制为股份制公司并成功登陆新三板。公司总部坐落在中国北京中关村科技园古城基地。是集研发，生产，出口销售的互联网+新材料制造企业。

公司主营金属基陶瓷复合材料，耐磨耐热材料，冶金、矿山、水泥、燃煤热电厂设备配件等。产品：高铬陶瓷复合铸造耐磨材料，马氏体钢陶瓷复合铸造耐磨耐冲击材料及各类高锰钢陶瓷复合材料，金属基陶瓷纤维复合材料。

Beijing JinMei Entrepreneur Co., Ltd (DJM) was established in 2006, Headquarter located in Zhongguancun High-tech Park in Beijing, China. DJM was restructured into Joint-Stock company & listed on NEEQ in 2016. DJM's a research and development, production, export sales of Internet + new materials manufacturing enterprises.

DJM is focusing on Metal Matrix Ceramic Composite (MMCC) material, wear-resistant and heat-resistant material.

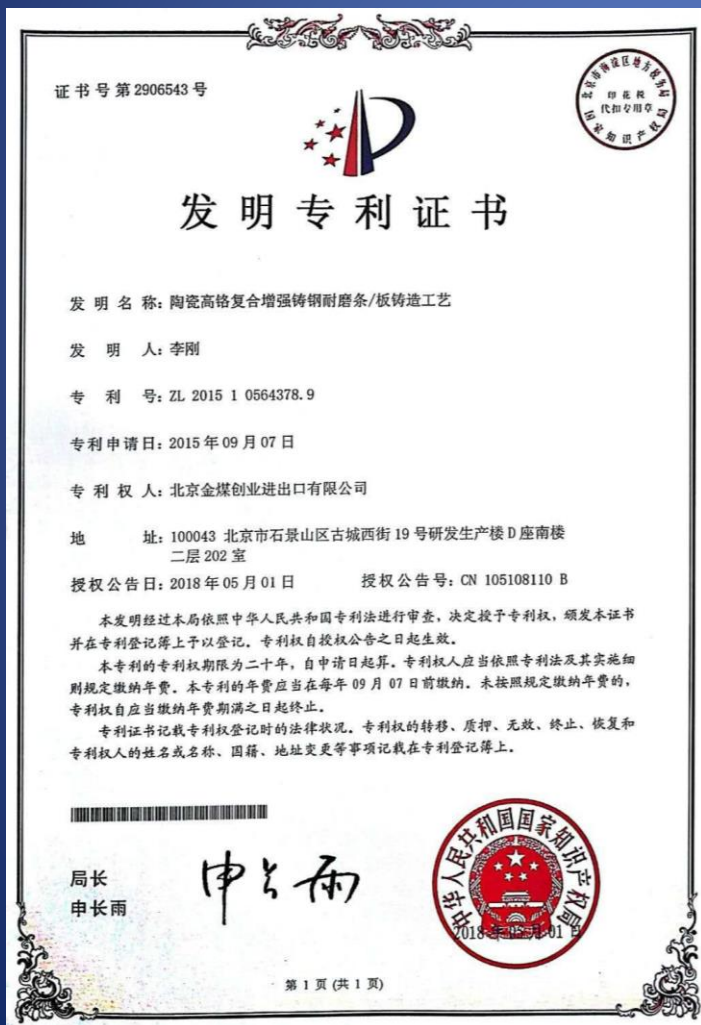
Products: High chromium cast iron ceramic composite castings, Martensite steel ceramic composite castings, high manganese steel ceramic composite castings, and Metal matrix ceramic fibre composite casting materials, ZTA ceramic mechanical parts. Products are widely used in metallurgical industry, mining, cement, Coal-fired thermal power plant as spare parts.



# 发明专利证书 Patent certificate

陶瓷高铬复合增强铸钢耐磨条板铸造工艺  
Metal Matrix ceramic composite casting

陶瓷高锰钢复合耐磨件铸造工艺  
High Mn Steel Matrix ceramic composite casting



# MMC- 金属基陶瓷颗粒复合铸造生产技术

## Metal matrix ceramic particle insert casting Technology

- 金属基陶瓷复合铸造工艺是将合金化后的陶瓷颗粒与基体金属通过冶金铸造工艺融合形成陶瓷颗粒与金属的复合层，实现金属基体与增强相的浸润和复合，陶瓷颗粒与金属的冶金结合是通过金属液体的热量传导来实现的，增强相的组织结构特征使其具有很高的强度和耐磨性能，可有效控制增强相厚度并实现大面积复合，使增强相与金属基体融合在一起没有明显界限，提高其耐磨寿命；复合材料层的耐热耐磨性能是高铬材料的3-4倍，同时复合材料层厚度可达原零件厚度的1/3以上，陶瓷复合层大大提高了产品的使用寿命，使用寿命是传统材料的几倍。
- 陶瓷本身具有耐高温（烧结温度1700度）、高硬度（HV2100）、高耐磨、抗氧化的性能，陶瓷颗粒弥散分布于金属基体中极好解决了两相热膨胀不一致的问题，合金化后的陶瓷颗粒与基体金属实现冶金结合解决陶瓷颗粒脱落的问题，陶瓷颗粒与基体金属组成的复合层可以充分发挥陶瓷的耐热抗氧化耐磨性能且具有基体金属的机械性能，从而满足恶劣工况条件下的耐热抗氧化耐磨要求
- 陶瓷复合层的蜂窝结构保持基体金属的原有机械性能特性，并可以充分发挥基体金属的机械性能特性，基体金属与陶瓷颗粒形成优势互补的复合层。在使用初期，陶瓷复合层中的基体金属会首先磨损并形成凹陷，弥散分布于金属基体中陶瓷颗粒会逐渐凸出于基体金属，凸起后的陶瓷颗粒开始对基体金属形成保护作用，利用自身的耐热耐磨性能阻断磨削力及热辐射传递，改变磨削力及热辐射传递方向，形成阴影效应减少基体金属磨损。
- 耐热钢在高温环境下会在金属表面形成氧化层，氧化层的厚度，氧化层剥落面积，剥落时间决定了它的使用寿命，氧化层每剥落一层金属即耗损一层直至完全失效，弥散分布于基体金属的陶瓷颗粒能适当强化晶粒，减少晶界数量，且将基体金属表面形成的氧化层分割成更小的氧化层区域，更小的氧化层区域更容易形成比较薄的氧化层，更小的氧化层区域每次剥落的氧化层更小，从而减缓基体金属氧化层的剥落时间，减少剥落面积及剥落厚度，提高有效使用寿命
- Metal-based ceramic composite casting process is to melt alloyed ceramic particles and matrix metal through metallurgical casting process to form a composite layer of ceramic particles and metal, so as to realize the infiltration and composite of metal matrix and reinforcement phase. The metallurgical combination of ceramic particles and metal is realized through the heat conduction of metal liquid. The microstructure characteristics of the reinforced phase make it have high strength and wear resistance, which can effectively control the thickness of the reinforced phase and realize large-area composite, so that the reinforced phase and the metal matrix are fused together without obvious boundaries, and the wear resistance life is improved. The heat and wear resistance of the composite layer is 3-4 times that of the high chromium material, and the thickness of the composite layer can reach more than 1/3 of the thickness of the original part. The ceramic composite layer greatly improves the service life of the product, and the service life is several times that of the traditional material.
- Ceramic itself has high temperature resistance (sintering temperature 1700 degrees), high hardness (HV2100), high wear resistance, anti-oxidation properties, ceramic particles dispersed in the metal matrix to solve the problem of inconsistent two-phase thermal expansion, alloyed ceramic particles and matrix metal to achieve metallurgical combination to solve the problem of ceramic particles falling off. The composite layer composed of ceramic particles and matrix metal can give full play to the heat resistance, oxidation resistance and wear resistance of ceramic and the mechanical properties of matrix metal, so as to meet the requirements of heat resistance, oxidation resistance and wear resistance under harsh working conditions
- The honeycomb structure of the ceramic composite layer maintains the original mechanical properties of the matrix metal, and can give full play to the mechanical properties of the matrix metal, and the matrix metal and ceramic particles form a complementary composite layer. In the initial stage of use, the matrix metal in the ceramic composite layer will first wear and form a depression, and the ceramic particles dispersed in the matrix metal will gradually protruding from the matrix metal. The raised ceramic particles will begin to form a protective effect on the matrix metal, and use its own heat and wear resistance to block the grinding force and heat radiation transfer, changing the direction of the grinding force and heat radiation transfer. Formation of shadow effect to reduce matrix metal wear.
- The heat-resistant steel will form an oxide layer on the metal surface in a high temperature environment, the thickness of the oxide layer, the area of the oxide layer, the peeling time determines its service life, each layer of the oxide layer of metal is lost until the complete failure, the ceramic particles dispersed in the matrix metal can properly strengthen the grain, reduce the number of grain boundaries, And the oxide layer formed on the surface of the base metal is divided into smaller oxide layer regions, smaller oxide layer regions are easier to form a relatively thin oxide layer, and smaller oxide layer regions each time the peeling layer is smaller, thereby slowing down the peeling time of the base metal oxide layer, reducing the peeling area and peeling thickness, and improving the effective service life



## MMC

### 金属基陶瓷颗粒复合铸造生产技术

Metal matrix ceramic particle insert casting Technology

高铬陶瓷复合铸造耐磨材料 (MMC-Cr)

High chrome ceramic insert composite wear-resistant castings

合金钢陶瓷复合铸造耐磨耐冲击材料 (MMC-M)

Alloy steel ceramic insert composite wear-resistant castings

高锰钢陶瓷复合铸造耐磨材料 (MMC-Mn)

High manganese ceramic insert composite wear-resistant castings

耐热钢陶瓷复合耐热抗磨材料 (MMC-HT)

Heat resistant steel Ceramic insert Wear/Heat-resistant castings

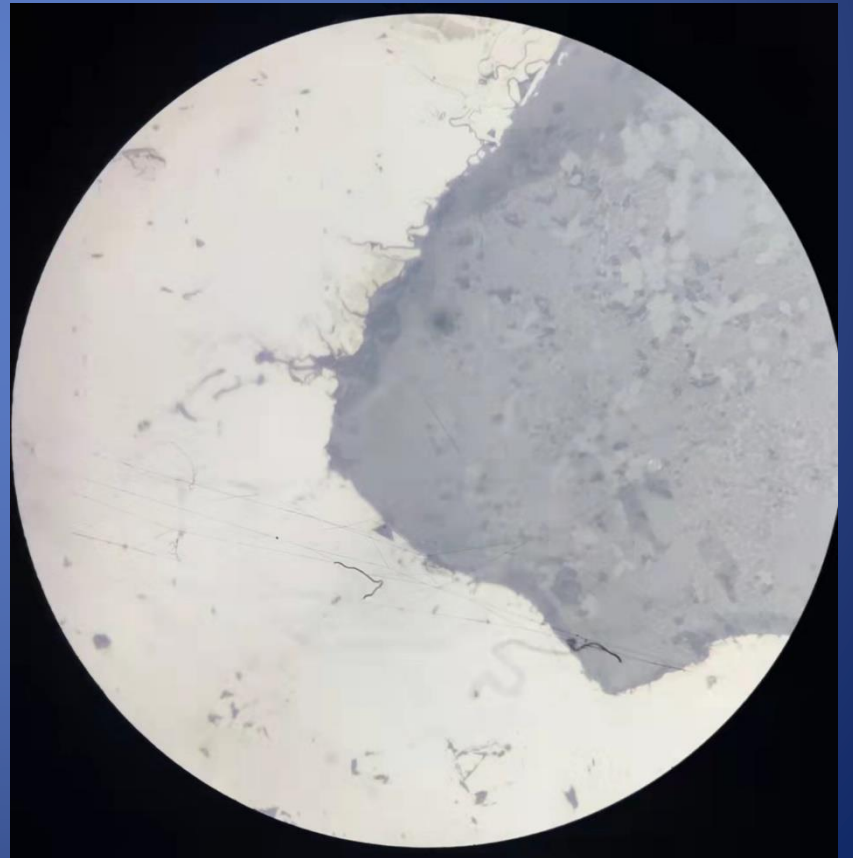
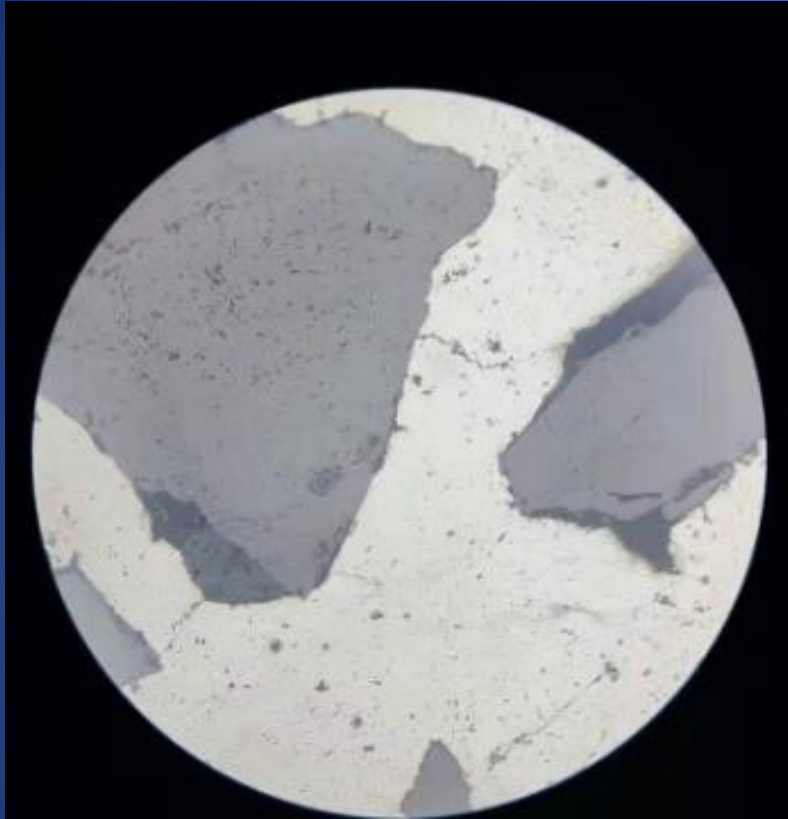
双金属陶瓷复合 (三相复合) 铸造耐磨材料 (MMC-B)

Bimetallic ceramic insert composite (three-phase composite) wear-resistant castings

## 陶瓷复合耐磨材料的硬度/金相组织 Hardness / metallography of Ceramic insert castings

-  The hardness of (MMC-Mn) the High manganese steel ceramic composite layer is distributed in steps:
  - Ceramic particles hardness= HV2100
  - Hardness of metal around ceramic particles = 60-65HRC
  - Basis material=High manganese steel =Hardness HB190-220
  - Impact hardness of High manganese steel = HB400-500
  - Metallography is austenite and carbide
  - It is suitable for use under high impact and high wear conditions
  - the service life of high manganese steel ceramic insert castings is more than 1 times of that of conventional high manganese steel
-  The hardness of (MMC-Cr) the High chromium iron ceramic composite layer is distributed in steps:
  - Ceramic particles hardness= HV2100
  - Hardness of metal around ceramic particles = 60-65HRC
  - Hardness of Basis material =High chromium iron = 58-62HRC
  - Metallography is Chromium-austenite and M7C3 eutectic carbide and chromium-troosite and M7C3 eutectic carbide
  - Suitable for use under low impact and high wear conditions
  - The biggest advantage of our Ceramic insert casting technology is that it greatly improves the service life of the product. The life span is several times of the traditional material.
-  The hardness of the (MMC-M) Martensite Steel ceramic composite layer is distributed in steps:
  - Ceramic particles hardness= HV2100
  - Hardness of metal around ceramic particles = 58-63HRC
  - Hardness of Basis material =Martensite Steel = 48-53HRC
  - Metallography is Martensite, residual austenite and undissolved carbide composition
  - It is suitable for use under high impact and high wear conditions and can be welded
-  MMC-B - Bimetallic ceramic insert composite casting、 The hardness of the three-phase complex shows a step distribution:
  - Hardness of matrix GGG = HB 130-180, tensile strength  $\sigma_b$  (MPa) :  $\geq 400$ , conditional yield strength  $\sigma_{0.2}$  (MPa) :  $\geq 250$ , impact toughness value  $\alpha_{kv}$  (J/cm<sup>2</sup>) :  $\geq 10$
  - Ceramic particle hardness = HV2100
  - Metal hardness around ceramic particles = 60-65HRC
  - High chromium cast iron inlay strip hardness = 58-62HRC
  - The metallographic structure of high Cr cast iron is chrome-austenite and M7C3 eutectic carbide, chrome-troosite and M7C3 eutectic carbide
  - Suitable for unit weight of castings over 3000kg、 use under low impact and high wear conditions
-  MMC-H - Heat resistant steel ceramic insert casting

陶瓷与金属界面金相  
Ceramics and metal interface metallography



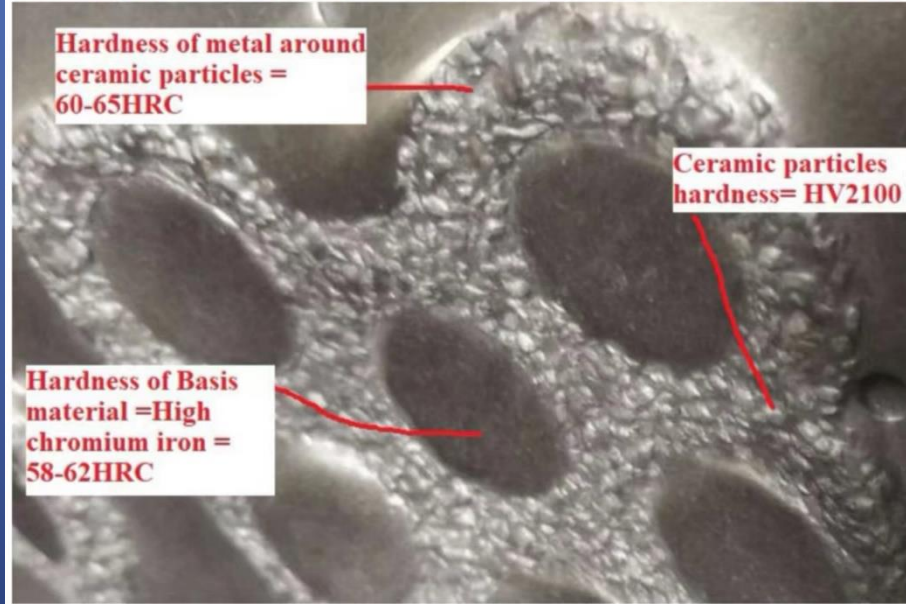
# 陶瓷复合铸造用陶瓷芯 Ceramic Core for Ceramic insert casting



Hardness of metal around  
ceramic particles =  
60-65HRC

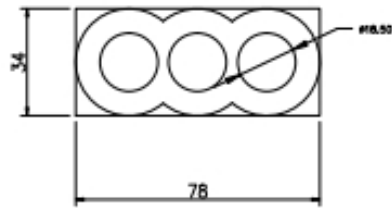
Ceramic particles  
hardness= HV2100

Hardness of Basis  
material =High  
chromium iron =  
58-62HRC

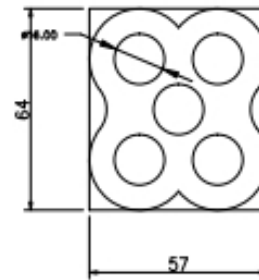




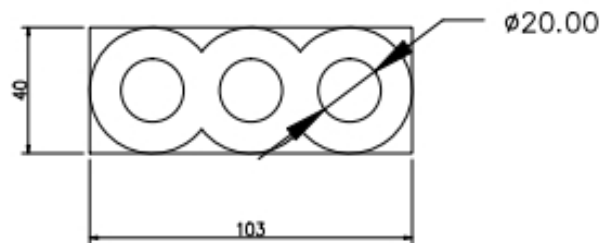
陶瓷芯形状/尺寸  
Ceramic core technical specifications



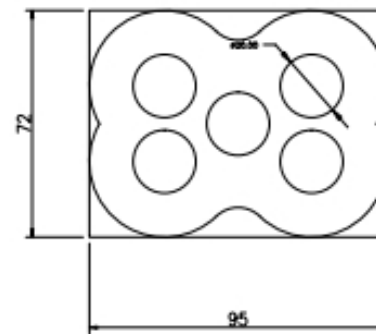
小三 6.75g/mm



小五孔 7.75g/mm



大三孔 8.85g/mm



大五孔 13.68g/mm

## 陶瓷复合耐磨产品-造型 Ceramic insert castings - sand molding

我们的陶瓷芯可应用于树脂砂铸造，水玻璃砂铸造，真空铸造，消失模铸造等。陶瓷复合产品的造型适用基材材质的常规造型工艺，但浇口杯/浇口/浇道/冒口的形状/位置/尺寸要根据DJM的技术要求做适当调整

The ceramic cores can be applied to resin sand casting, water glass sand casting, vacuum casting, and lost foam casting., The sand molding of ceramic insert castings is suitable for the conventional molding process, but the shape / position / size of the pouring cup / sprue / runner / riser should be adjusted according to the technical requirements of DJM

## 陶瓷复合耐磨产品-熔炼 / 浇铸 Ceramic insert castings-Smelting / pouring

该工艺适用于生产高锰钢、高铬铸铁、耐热钢和合金钢等耐磨件。陶瓷复合产品的钢水熔炼/浇铸适用基材材质的常规冶炼/浇铸工艺，但钢水化学成分/钢水温度/浇铸温度要根据DJM的技术要求做适当调整

the technology is suitable for production of high manganese steel, high chrome cast iron, heat resistant steel and alloy steel wear parts., The molten steel smelting of ceramic insert castings is applicable to the conventional smelting process / pouring process of the basis material, but the chemical composition of molten steel/molten steel temperature/pouring temperature should be adjusted appropriately according to the technical requirements of DJM

## 陶瓷复合耐磨产品-浇冒口切割/清理/打磨/机加工 Ceramic insert castings- pouring and riser cutting/cleaning/grinding/machining

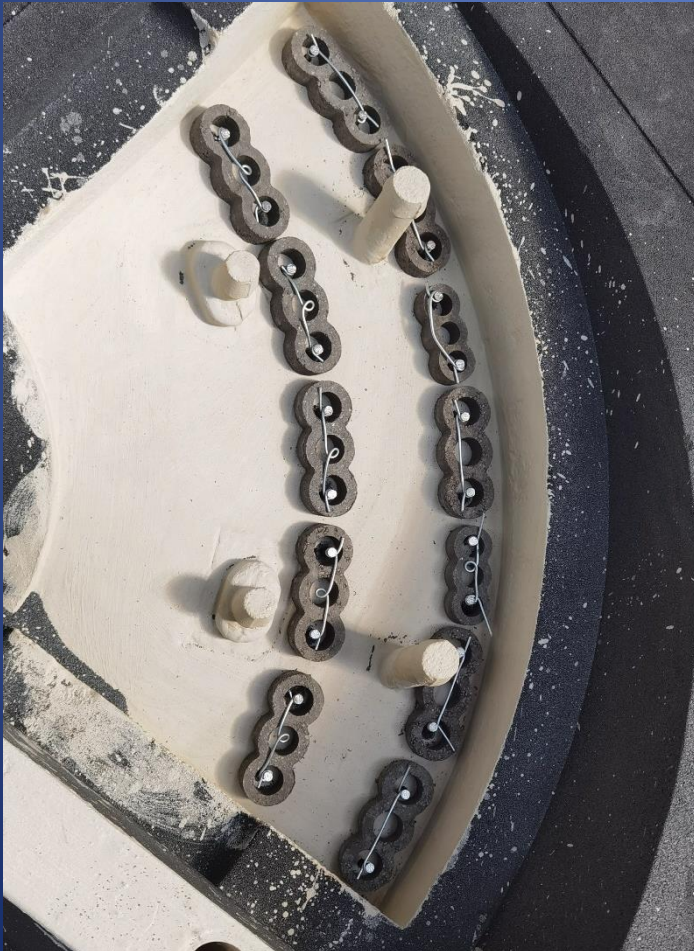
陶瓷复合产品的浇冒口切割/清理/打磨/机加工适用基材材质的常规工艺，陶瓷复合层表面适用仅砂轮磨削处理，设计陶瓷布局时应尽量避免在机加工位置布置陶瓷

The pouring and riser cutting/cleaning/grinding/machining of ceramic insert composite products applies to the conventional process of the basis material, and the surface of the ceramic insert composite layer applies to the grinding process only. The ceramic layout should be avoided in the machining position when designing the ceramic layout

## 砂铸工艺陶瓷布局及安装

### installation and layout of Ceramic core of Sand casting process

- DJM通常根据铸造图纸选择陶瓷芯的形状类型和尺寸。我们会根据铸造图纸设计铸造工艺，布置陶瓷，并选择陶瓷芯的类型、尺寸，陶瓷芯使用起来非常简单方便，根据我们设计的铸造工艺将陶瓷芯用钉子或自攻螺钉固定在砂型上即可。
- DJM usually selects the shape type and size of the ceramic core according to the casting drawings. We will design the casting process according to the casting drawings, arrange the ceramics, and choose the type and size of the ceramic core. The ceramic core is very simple and convenient to use. According to the casting process designed by us, the ceramic core can be fixed on the sand mold with nails or self-tapping screws.



砂铸工艺合金钢陶瓷复合锤头的陶瓷布局及安装

installation and layout of Ceramic core for Alloy steel ceramic insert casting Hammer of Sand casting process



# 砂铸工艺合金钢陶瓷复合球磨机衬板的陶瓷布局及安装

installation and layout of Alloy steel ceramic insert casting Ball mill liner of Sand casting process



# 水玻璃砂铸工艺高锰钢陶瓷复合齿板的陶瓷布局及安装

installation and layout of Ceramic core for high manganese steel ceramic insert casting Jaw Plate of Sand casting process



水玻璃砂铸工艺高锰钢陶瓷复合轧臼壁的陶瓷布局及安装

installation and layout of Ceramic core for high manganese steel ceramic insert casting Mantle / Bowl of Sand casting process



high manganese steel ceramic insert casting Cone

19:38 ✓



19:39

high manganese steel ceramic insert casting mantle

19:44 ✓



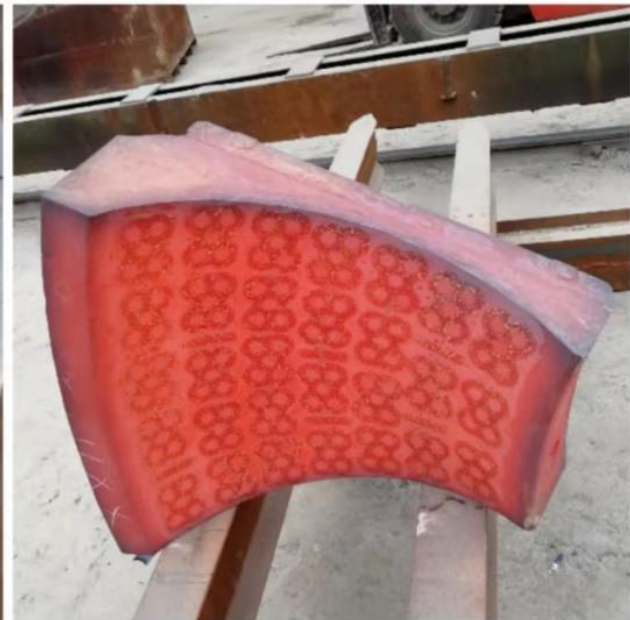
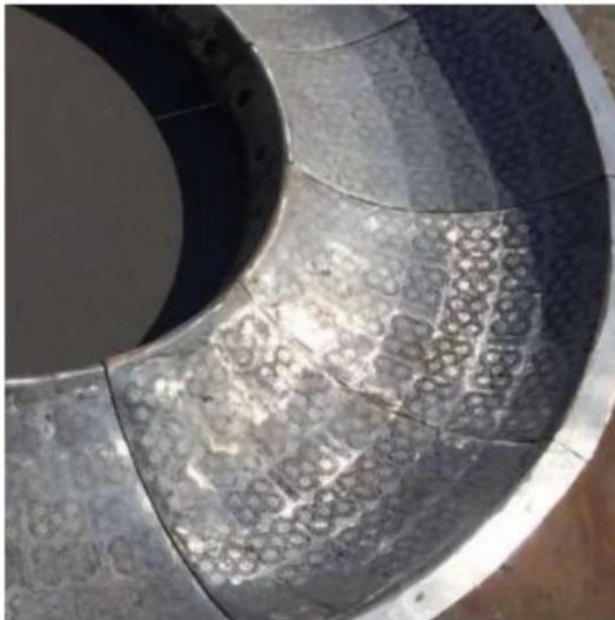
19:39



19:47 ✓

砂铸工艺高铬陶瓷复合衬板的陶瓷布局及安装

installation and layout of Ceramic core for high Chrome cast iron ceramic insert casting Liner of Sand casting process





树脂砂铸工艺高铬陶瓷复合衬板的陶瓷布局及安装

installation and layout of Ceramic core for high Chrome cast iron ceramic insert casting Liner of Sand casting process



### V法工艺高铬陶瓷复合板锤的陶瓷布局及安装

installation and layout of Ceramic core for high Chrome cast iron ceramic insert casting Blow Bar of vacuum casting process



V法铸造工艺高锰钢陶瓷复合齿板的陶瓷布局及安装

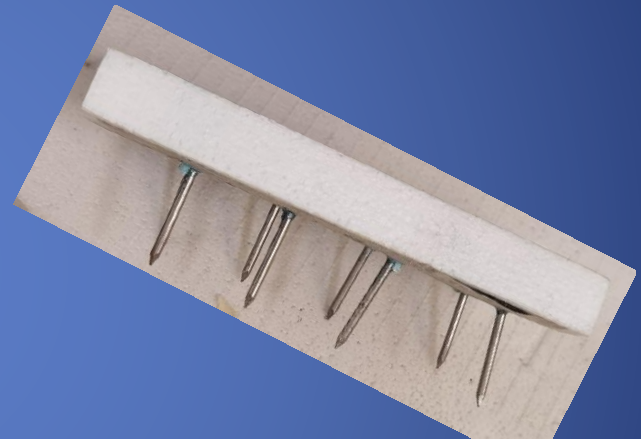
installation and layout of Ceramic core for high manganese steel ceramic insert casting Jaw Plate of vacuum casting process



## 陶瓷板锤消失模铸造工艺陶瓷布局及安装

### installation and layout of Ceramic core of Lost foam casting process for ceramic insert blow bar

- DJM通常根据铸造图纸选择陶瓷芯的形状类型和尺寸。我们会根据铸造图纸设计铸造工艺，布置陶瓷，并选择陶瓷芯的类型、尺寸，陶瓷芯使用起来非常简单方便，根据我们设计的铸造工艺将陶瓷芯用钉子、胶水固定在泡沫型上然后上涂料、烘干即可埋箱浇铸。
- DJM usually selects the shape type and size of the ceramic core according to the casting drawings. We will design the casting process according to the casting drawings, arrange the ceramics, and choose the type and size of the ceramic core. The ceramic core is very simple and convenient to use. According to the casting process designed by us, the ceramic core is fixed on the foam type with nails and glue, and then coated and Dry can be buried box casting



消失模铸造工艺合金钢陶瓷复合球磨机衬板的陶瓷布局及安装

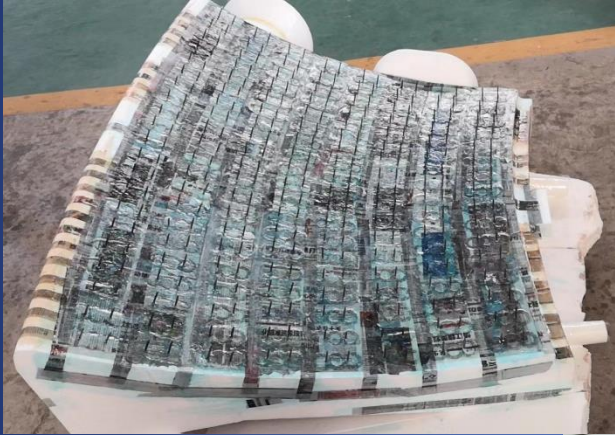
installation and layout of Alloy steel ceramic insert casting Ball mill liner of Sand casting process of Lost foam casting process



消失模铸造工艺高铬陶瓷复合辊套的陶瓷布局及安装  
installation and layout of Ceramic core for high Chrome cast iron ceramic insert casting Roller of Lost foam casting process



消失模铸造工艺高铬陶瓷复合碾底衬板的陶瓷布局及安装  
installation and layout of Ceramic core for high Chrome cast iron ceramic insert casting Liner of Lost foam casting process



消失模铸造工艺高锰钢陶瓷复合轧白壁陶瓷布局及安装  
installation and layout of Ceramic core for high manganese steel ceramic insert casting Mantle / Bowl of Lost foam casting process





消失模铸造工艺耐热钢陶瓷复合衬板的陶瓷布局及安装  
ceramic installation and layout of Heat resistant steel ceramic insert casting liner of Lost foam casting process



消失模铸造工艺合金钢陶瓷复合锤头的陶瓷布局及安装

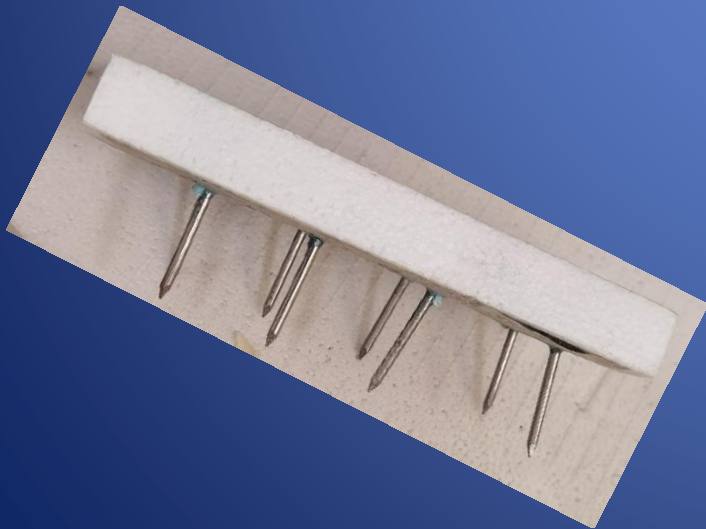
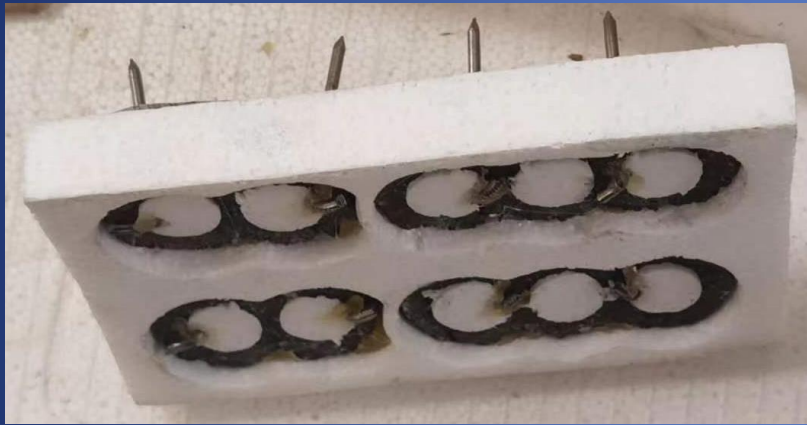
installation and layout of Alloy steel ceramic insert casting Hammer of Sand casting process of Lost foam casting process



## 锤头消失模铸造工艺陶瓷布局及安装

### installation and layout of Ceramic core of Lost foam casting process for Hammer

- DJM通常根据铸造图纸选择陶瓷芯的形状类型和尺寸。我们会根据铸造图纸设计铸造工艺，布置陶瓷，并选择陶瓷芯的类型、尺寸，陶瓷芯使用起来非常简单方便，根据我们设计的铸造工艺将陶瓷芯用钉子、胶水固定在泡沫型上然后上涂料、烘干即可埋箱浇铸。
- DJM usually selects the shape type and size of the ceramic core according to the casting drawings. We will design the casting process according to the casting drawings, arrange the ceramics, and choose the type and size of the ceramic core. The ceramic core is very simple and convenient to use. According to the casting process designed by us, the ceramic core is fixed on the foam type with nails and glue, and then coated and Dry can be buried box casting



## 陶瓷复合耐磨产品-热处理 Ceramic insert castings - Heat treatment

陶瓷复合产品的热处理适用于基材材质的常规热处理工艺，但升温曲线/降温曲线要根据DJM的技术要求做适当调整  
The heat treatment of ceramic composite products is suitable for the conventional heat treatment process of substrate materials, but the temperature rise curve/cooling curve should be adjusted according to the technical requirements of DJM



## 陶瓷复合耐磨产品-检测

### Ceramic insert castings - Inspection

- 陶瓷复合产品的检测适用基材材质的常规检测工艺，但要根据DJM的技术要求对复合层进行硬度、金相、着色、表面冲击等检测
- The testing of ceramic composite products is applicable to the conventional Inspection process of the basis material, but the hardness, metallography、Surface impact and Penetrant Inspection of the composite layer should be tested according to the technical requirements of DJM
  
- 着色检测：Penetrant Inspection according to ISO 3542 （or EN1371）
- 基体着色检测
- basis material Penetrant Inspection， To meet the base material standard Penetrant test requirements
- 陶瓷复合层着色检测
- Ceramic composite layer Penetrant Inspection， To meet the base material standard Penetrant test requirements
  
- 硬度检测：Hardness testing according to ISO 6508
- 基体硬度
- basis material hardness， To meet the base material standard hardness test requirements
- 陶瓷周围金属硬度
- Hardness of metal around ceramics， To meeting DJM ceramic composite layer ladder hardness distribution requirements
  
- 金相检测：metallography testing according to ISO/TR 20580 （or ASTM E3和ASTM E407）
- 基体金相
- basis material metallography， To meet the base material standard metallography requirements
- 陶瓷周围金属金相
- Ceramic surrounding metal metallography, To meet the base material standard metallography requirements
- 陶瓷与金属界面金相
- Ceramics and metal interface metallography， To meet the DJM ceramic composite layer metallography requirements
  
- 陶瓷复合层表面冲击检测：Testing of Ceramic composite layer Surface impact
- 用冲击锤对复合层表面进行连续冲击1分钟以上，复合层不能有断裂、不能有陶瓷颗粒脱落、不能有严重凹陷等缺陷
- The impact hammer is used to continuously impact the surface of the ceramic composite layer for more than 1 minute, and the ceramic composite layer cannot be broken, can not have ceramic particles fall off, can not have serious depression and other defects
  
- **Note:**
- 所有金相检测点、硬度检测点不要刷漆
- All metallographic inspection points, hardness inspection points do not paint

# MMC-Cr 高铬铸铁陶瓷复合耐磨材料

MMC-Cr ( High Chromium cast iron matrix ceramic insert casting wear-resistant material )

## MMC-Cr ( High Chromium cast iron matrix ceramic insert casting wear-resistant material )

That is, the reinforcement phase - ceramic particles are fused and cast in the easily worn parts of metal parts with high chromium cast iron as the base material. The metal-ceramic composite layer is formed by the metallurgical combination of ceramic particles and casting alloy. The metallurgical bonding of ceramic particles with metal is realized by the heat of metal liquid. The hardness of ceramic-ceramic composite layer formed by ceramic particles and matrix metal shows a step distribution. The hardness of ceramic particles in the composite layer can reach 3-4 times of the hardness of high chromium cast iron material, so as to achieve the anti-wear effect; Compared with ordinary high chromium cast iron, the service life of the product is greatly extended.

The hardness of the High chromium iron ceramic composite layer is distributed in steps:

Ceramic particles hardness= HV2100

Hardness of metal around ceramic particles = 60-65HRC

Hardness of Basis material =High chromium iron = 58-62HRC

Metallography is Chromium-austenite and M7C3 eutectic carbide and chromium-troosite and M7C3 eutectic carbide

Suitable for use under low impact and high wear conditions

### MMC-Cr 高铬铸铁陶瓷复合耐磨材料

即在高铬铸铁为基材的金属部件易磨损部位熔铸增强相-陶瓷颗粒.通过陶瓷颗粒与铸造合金的冶金结合来实现金属陶瓷复合并形成金属陶瓷复合层;陶瓷颗粒与金属的冶金结合是通过金属液体的热量来实现的;陶瓷颗粒与基体金属形成金属陶瓷复合层的硬度呈阶梯分布:复合层中陶瓷颗粒的硬度可达高铬铸铁材料硬度的3-4倍,从而实现抗磨的效果;与普通高铬铸铁件相比,产品使用寿命大幅度延长。

高铬陶瓷复合层的硬度呈阶梯分布:

陶瓷颗粒硬度= HV2100

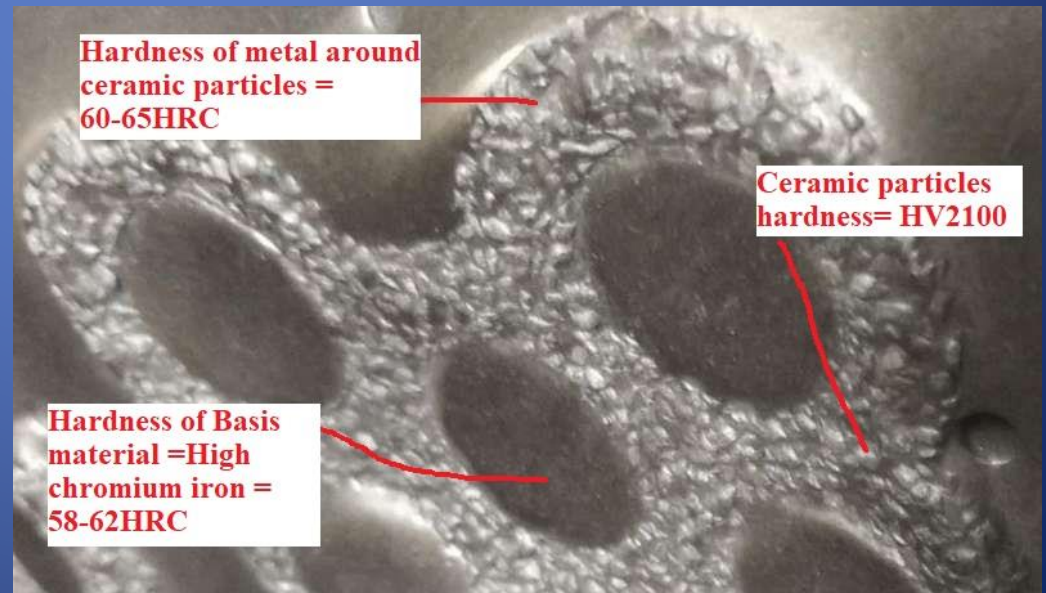
陶瓷颗粒周围的金属硬度= 60-65HRC

基材硬度=高铬铸铁= 58-62HRC

金相组织为铬-奥氏体和M7C3共晶碳化物,

铬-屈氏体和M7C3共晶碳化物

适合在低冲击和高磨损条件下使用





# MMC-M 马氏体钢陶瓷复合耐磨材料

## MMC-M (Martensite steel matrix ceramic Insert casting Wearparts)

### MMC-M (Martensite steel matrix ceramic insert casting wear-resistant material)

That is, the reinforcement phase - ceramic particles are cast in the easily worn parts of the metal parts with martensitic steel as the base material. The metal-ceramic composite layer is formed by the metallurgical combination of ceramic particles and casting alloy. The metallurgical bonding of ceramic particles with metal is realized by the heat of metal liquid. The hardness of ceramic-ceramic composite layer formed by ceramic particles and matrix metal is distributed in a step: give full play to the characteristics of high strength and high hardness of martensitic steel, reduce the plastic deformation of metal parts, and improve the impact resistance; Combined with the high wear resistance of ceramic particles, the anti-wear performance of the working surface is improved. The result is a metal component that is both wear resistant and impact resistant. Due to the selection of martensitic steel as the base material, so that the composite material has a good welding, and processing properties, while the product is suitable for flame gas cutting, grinding wheel saw, shear, water cutting, plasma and other cutting methods, welding without preheating or subsequent heating treatment; Compared with ordinary high chromium cast iron, the service life of the product is greatly improved.

The hardness of the Martensite Steel ceramic insert composite layer is distributed in steps:

Ceramic particles hardness= HV2100

Hardness of metal around ceramic particles = 58-63HRC

Hardness of Basis material =Martensite Steel = 48-53HRC

Metallography is Martensite, residual austenite and undissolved carbide composition

It is suitable for use under high impact and high wear conditions and can be welded

### MMC-M 马氏体钢陶瓷复合耐磨材料

即在马氏体钢为基材的金属部件易磨损部位熔铸增强相-陶瓷颗粒.通过陶瓷颗粒与铸造合金的冶金结合来实现金属陶瓷复合并形成金属陶瓷复合层;陶瓷颗粒与金属的冶金结合是通过金属液体的热量来实现的;陶瓷颗粒与基体金属形成金属陶瓷复合层的硬度呈阶梯分布:充分发挥马氏体钢的高强度及高硬度特点,减少金属部件的塑性变形,提高抗冲击能力;结合陶瓷颗粒的高耐磨特性,提高工作面的抗磨性能;从而获得即耐磨且抗冲击的金属部件。因选用马氏体钢为基材,从而使复合材料具有很好的焊接,及加工性能,同时产品适用火焰气割,砂轮锯,剪切,水割,等离子等多种切割方式切割,焊接时无需对其进行预热或后续加热处理;与普通高铬铸铁件相比,产品使用寿命大幅度提高。

马氏体钢陶瓷复合层的硬度分布:

陶瓷颗粒硬度= HV2100

陶瓷颗粒周围的金属硬度= 60-65HRC

基体硬度=马氏体钢硬度= 48-53HRC

金相组织为马氏体、残余奥氏体和未溶碳化物组成  
适合在高冲击、高磨损条件下使用,可焊接





## MMC-Mn高锰钢陶瓷复合耐磨材料

### MMC-Mn (High Manganese Steel Ceramic Insert casting wearparts)

#### MMC-Mn (High-manganese ceramic insert casting wear-resistant material)

That is, the reinforcement phase - ceramic particles are fused and cast in the easily worn parts of metal parts with high manganese steel as the base material. The metal-ceramic composite layer is formed by the metallurgical combination of ceramic particles and casting alloy. The metallurgical bonding of ceramic particles with metal is realized by the heat of metal liquid. The hardness of ceramic-ceramic composite layer formed by ceramic particles and matrix metal shows a step distribution. In the casting engineering, alloy elements in composite ceramic materials are used to refine the grain of high-manganese steel, improve the matrix properties of high-manganese steel, give full play to the work-hardening characteristics of high-manganese steel, reduce plastic deformation, and improve the low-impact wear resistance. Combined with the high wear resistance of the ceramic material, the wear resistance of the working surface is improved, so that the wear-resistant and impact-resistant material is obtained. The life of high manganese steel ceramic composite is greatly improved.

The hardness of the High manganese steel ceramic insert composite layer is distributed in steps:

Ceramic particles hardness= HV2100

Hardness of metal around ceramic particles = 60-65HRC

Basis material=High manganese steel =Hardness HB190-220

Impact hardness of High manganese steel = HB400-500

It is suitable for use under high impact and high wear conditions

#### MMC-Mn 高锰钢陶瓷复合耐磨材料

即在高锰钢为基材的金属部件易磨损部位熔铸增强相-陶瓷颗粒.通过陶瓷颗粒与铸造合金的冶金结合来实现金属陶瓷复合并形成金属陶瓷复合层;陶瓷颗粒与金属的冶金结合是通过金属液体的热量来实现的;陶瓷颗粒与基体金属形成金属陶瓷复合层的硬度呈阶梯分布:在浇铸工程中利用复合陶瓷材料中的合金元素细化高锰钢晶粒,提高高锰钢基体性能,充分发挥高锰钢的加工硬化特点,减少塑性变形,提高低冲击耐磨能力;结合陶瓷材料的高耐磨特性,提高工作面的抗磨性能,从而获得即耐磨且抗冲击的耐磨材料。高锰钢陶瓷复合材料的寿命大幅度提高。

高锰钢陶瓷复合层的硬度呈阶梯分布:

陶瓷颗粒硬度= HV2100

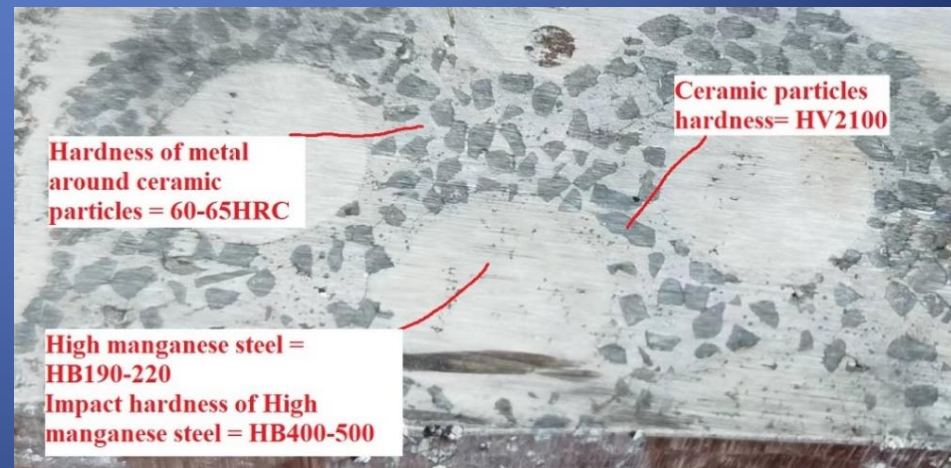
陶瓷颗粒周围的金属硬度= 60-65HRC

基材=高锰钢=硬度HB190-220

高锰钢冲击硬度= HB400-500

金相组织为奥氏体和碳化物

适合在高冲击、高磨损条件下使用







## MMC-B 双金属陶瓷复合（三相复合）立磨辊套 MMC-B Bimetallic ceramic insert composite (three-phase composite) casting Roller MMC GGG + High Chrome Cast Iron + ZTA Ceramic particles

DJM 选用球铁基高铬陶瓷复合材料，即：在高铬材料中熔铸陶瓷颗粒形成高铬陶瓷金属复合材料层，选用球铁为辊套基体，在辊套表面熔铸高铬陶瓷复合层，这层复合层的耐磨性能可达高Cr材料的3-4倍，同时这一复合层的厚度可制成达到原备件厚度的1/3，并可根据原磨损曲线有针对性的制作，球铁高铬陶瓷辊套和衬板磨煤时平均磨损量（磨损深度）每1000小时为2-4mm，而高铬辊套和衬板磨煤时平均磨损量（磨损深度）每1000小时为5-9mm，球铁高铬陶瓷辊套/衬板是高铬产品的三倍以上。

三相复合体的硬度呈阶梯分布：

基体GGG的硬度= HB 170-230、抗拉强度  $\sigma_b$  (MPa):  $\geq 500$ 、条件屈服强度  $\sigma_{0.2}$  (MPa):  $\geq 320$ 、冲击韧性值  $\alpha_{kv}$  (J/cm<sup>2</sup>):  $\geq 9$ 、

基体GGG的金相组织=珠光体+铁素体+球状石墨

陶瓷颗粒硬度= HV2100

陶瓷颗粒周围的金属硬度= 60-65HRC

高铬铸铁镶嵌条基材硬度= 58-62HRC

高铬铸铁镶嵌条金相组织为铬-奥氏体和M7C3共晶碳化物，铬-屈氏体和M7C3共晶碳化物

适合单重3吨以上的铸件，在低冲击和高磨损条件下使用

DJM selects a ductile iron based high chromium ceramic composite material, namely: High chromium ceramic metal composite material layer is formed by casting ceramic particles in high chromium material, ductile iron is selected as the matrix of roll sleeve, and high chromium ceramic composite layer is cast on the surface of roll sleeve. The wear resistance of this composite layer can reach 3-4 times that of high Cr material, and the thickness of this composite layer can be made to reach 1/3 of the thickness of the original spare part, and can be made according to the original wear curve. The average wear (wear depth) of the high chromium ceramic roller sleeve and liner is 2-4mm per 1000 hours, while the average wear (wear depth) of the high chromium roller sleeve and liner is 5-9mm per 1000 hours, and the high chromium ceramic roller sleeve/liner is more than three times that of the high chromium products.

The hardness of the three-phase composition castings shows a step distribution:

Hardness of matrix GGG = HB 170-230, tensile strength  $\sigma_b$  (MPa) :  $\geq 500$ , conditional yield strength  $\sigma_{0.2}$  (MPa) :  $\geq 320$ , impact toughness value  $\alpha_{kv}$  (J/cm<sup>2</sup>) :  $\geq 9$ ,

The metallographic structure of GGG is Pearlite + ferrite + spherical graphite

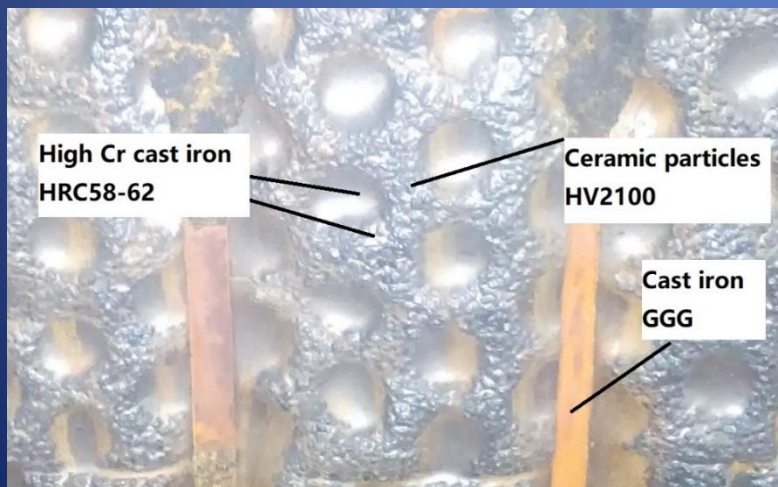
Ceramic particle hardness = HV2100

Metal hardness around ceramic particles = 60-65HRC

High chromium cast iron inlay strip hardness = 58-62HRC

The metallographic structure of high chromium cast iron is chrome-austenite and M7C3 eutectic carbide, chrome-ferrite and M7C3 eutectic carbide

Suitable for Unit weight of castings over 3000kg, use under low impact and high wear conditions





## (MMC-HT) 耐热钢陶瓷复合耐热抗磨材料 (MMC-HT) Heat resistant steel Ceramic insert Wear/Heat-resistant castings

DJM 选用耐热钢为基材与陶瓷颗粒复合铸造制得耐热钢陶瓷复合耐热耐磨材料，耐热钢在高温环境下会在金属表面形成氧化层，氧化层的厚度，氧化层剥落面积，剥落时间决定了它的使用寿命，氧化层每剥落一层金属即耗损一层直至完全失效；弥散分布于基体金属的陶瓷颗粒能适当强化晶粒，减少晶界数量，在使用过程中阻碍热传导，隔绝热对流，分散热辐射，且将基体金属表面形成的氧化层分割成更小的氧化层区域，更小的氧化层区域更容易形成比较薄的氧化层，更小的氧化层区域每次剥落的氧化层更小，从而减缓基体金属氧化层的剥落时间，减少剥落面积及剥落厚度，提高有效使用寿命

耐热钢陶瓷复合材料的硬度呈阶梯分布：

基体耐热钢的硬度=  $\leq 187\text{HB}$ 、抗拉强度  $\sigma_b$  (MPa) :  $\geq 590$ 、屈服强度  $\sigma_{0.2}$  (MPa) :  $\geq 295$ 、最高使用温度=  $1000^\circ\text{C}$ 。

基体耐热钢的金相组织=奥氏体型

陶瓷颗粒硬度=  $\text{HV}2100$ 、陶瓷颗粒最高使用温度=  $1500^\circ\text{C}$ 、

陶瓷颗粒周围的金属硬度=  $58\text{-}62\text{HRC}$

复合层最高使用温度=  $1100\text{-}1200^\circ\text{C}$ 、

适合在低冲击和高温条件下使用（使用寿命是Cr2520的两倍以上，水泥窑预热器挂片使用寿命2-3年，与碳化硅陶瓷挂片使用寿命相当）

DJM uses heat-resistant steel as the substrate and ceramic particles composite casting to make heat-resistant steel ceramic composite heat-resistant wear-resistant material. Heat-resistant steel will form an oxide layer on the metal surface under high temperature environment. The thickness of the oxide layer, the area of the oxide layer and the peeling time determine its service life. The ceramic particles dispersed in the matrix metal can properly strengthen the grains, reduce the number of grain boundaries, hinder heat conduction, isolate heat convection, disperse heat radiation during use, and divide the oxide layer formed on the surface of the matrix metal into smaller oxide layer regions, smaller oxide layer regions are more likely to form a relatively thin oxide layer, and smaller oxide layer regions each time the peeling oxide layer is smaller. Thus, the peeling time of the metal oxide layer is slowed down, the peeling area and peeling thickness are reduced, and the effective service life is improved

the hardness of heat-resistant steel ceramic composite material is a step distribution:

hardness of matrix heat-resistant steel =  $\leq 187\text{HB}$ , tensile strength  $\sigma_b$  (MPa) :  $\geq 590$ , conditional yield strength  $\sigma_{0.2}$  (MPa) :  $\geq 295$ ,

heat-resistant steel microstructure = Austenitic

ceramic particle hardness =  $\text{HV}2100$

ceramic particles around the metal hardness =  $58\text{-}62\text{HRC}$

suitable for use in low impact and high temperature conditions



陶瓷复合耐磨产品使用效果  
use effect of ceramic insert casting wearparts

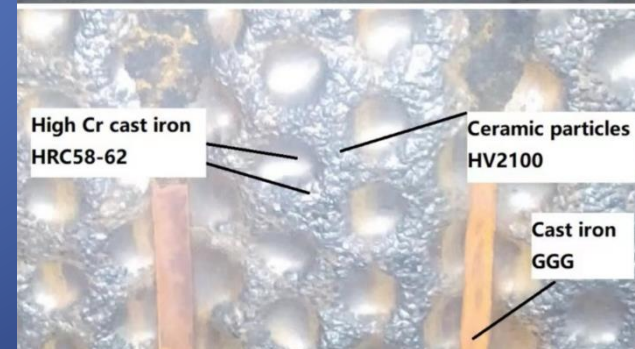
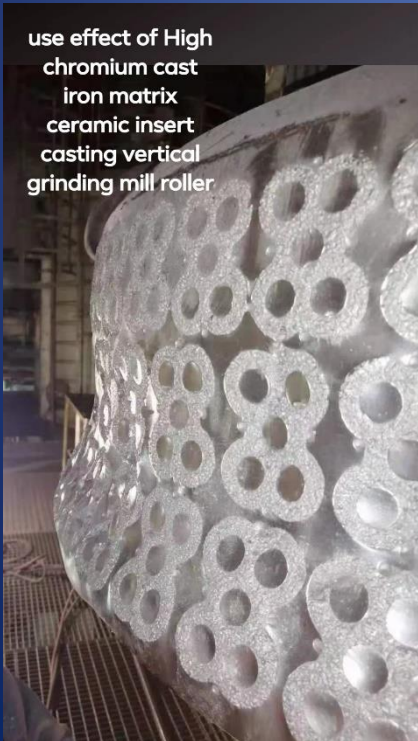


## 金属陶瓷复合铸造立磨辊套使用效果

### Use effect of Metal matrix ceramic insert casting Roller of Vertical Grinding Mill

- under normal conditions,
- The average wear depth of the high-chromium ceramic insert casting Roller and Bimetallic ceramic insert composite (three-phase composite) casting Roller of coal mill is 2-3mm per 1000 hours;
- The average wear depth of the high-chromium ceramic insert casting Roller and Bimetallic ceramic insert composite (three-phase composite) casting Roller of Raw mill is 4-6mm per 1000 hours;
- The average wear depth of the high-chromium ceramic insert casting Liner of coal mill is 1-2mm per 1000 hours;
- Bimetallic ceramic insert composite (three-phase composite) casting Roller is recommended when the weight of a single piece exceeds 3000kg
- 在正常情况下，磨煤机高铬陶瓷复合铸造辊套和双金属陶瓷复合(三相复合)铸造辊套的平均磨损深度为2 ~ 3mm / 1000小时;原料磨高铬陶瓷复合铸造辊和双金属陶瓷复合(三相复合)铸造辊套每1000小时的平均磨损深度为4 ~ 6mm;
- 磨煤机高铬陶瓷复合衬套每1000小时平均磨损深度为1 ~ 2mm;
- 单件重量超过3000kg时，推荐使用双金属陶瓷复合(三相复合)铸造辊套

use effect of High chromium cast iron matrix ceramic insert casting vertical grinding mill roller



# 立磨衬板使用实例

## the use of examples-Mill Liner

- 物料=4500大卡煤（HGI=60）
- 进料粒度= 30-50mm
- 磨损形式=高应力碾碎式磨粒磨损（grinding abrasion）
- 使用者及设备=燃煤发电厂ZGM95G立磨碾底衬板
- 高铬陶瓷复合衬板使用寿命=1200-20000小时 每千小时磨耗=1-2mm
- 水泥生料使用寿命= 每千小时磨耗=2-3mm



金属基陶瓷复合立磨辊套  
Roller of High Cr Cast Iron+ZTA Ceramic particles

Material	Cr26 辊套		Cr26 + Ceramic 辊套	
	使用寿命	产量	使用寿命	产量
石英砂	2000小时 (个3月)	3000-4000吨/每套辊套	10个月以上 8000小时	12000吨/每套 辊套
锂矿	2000-3000小时	3000-4000吨/每套辊套	8000小时以上	
煤	6000-8000小时		18000小时以上	
水泥生料	4000-6000小时		12000小时以上	



## 陶瓷复合雷蒙磨-磨辊-磨环使用寿命

### The service life of Ceramic insert Raymond mill-Ring-roller

Material: Clay + ceramic brick

the service life of conventional Ring-roller (Mn13) is 600hour

the service life of high manganese steel ceramic inset Raymond mill-Ring-roller is 1150hour

the service life of high chromium ceramic inset Raymond mill-Ring-roller is 1900hour.

物料: 粘土+陶瓷砖

传统环辊(Mn13)的使用寿命为600小时

高锰钢陶瓷复合雷蒙磨环辊使用寿命为1150小时

高铬陶瓷复合雷蒙磨环辊使用寿命为1900小时



# 陶瓷金属复合球磨机衬板使用效果

## using effect of Metal ceramic insert composite Ball mill liner

Cermet composite ball mill liner life comparison table

material	use conditions	High manganese steel liner life		Ceramic composite liner life	note
coal	Coal-fired thermal	24 months		96 months	
Raw material (limestone)	cement plant	7-8 months		24 months	
iron ore	concentrating mill	4-6 months		18 months	
aluminium ore	sintering	7-8 months		24 months	
copper ore	concentrating mill	4-6 months		18 months	
gold ore	concentrating mill	4-6 months		18 months	





金属陶瓷复合铸造自(半)磨机衬板  
Metal ceramic insert composite shell liner of SAG mill

Cermet composite SAG mill liner life comparison table

material	use condition	Alloy steel liner life		Ceramic composite liner life	note
iron ore	concentrating mill	4-6 months		12 months	
copper ore	concentrating mill	4-6 months		12 months	
gold ore	concentrating mill	4-6 months		12 months	



## 金属陶瓷复合铸造板锤使用效果

### Use effect of Metal matrix ceramic insert casting composite Blow bar

under normal conditions,

the service life of the F60/5 + ceramic is more than 1 times of that of the common marteniste steel ( F60/5 )

the service life of the Cr27Mo + ceramic is more than 1 times of that of the common high-chromium

the service life of the Cr27Mo + ceramic is more than 1-2 times of that of the common marteniste steel

the service life of the Cr27Mo + ceramic is more than 2-3 times of that of the common high manganese steel

under normal conditions

Unit Feed size; over 500mm. selected high manganese steel + ceramic

Unit Feed size; max 550mm selected marteniste steel + ceramic

Unit Feed size; Max 350mm selected High Cr + ceramic

The type of material is uncertain, Materials contain metals, such as construction waste: selected marteniste steel + ceramic



## 金属陶瓷复合铸造锤头使用效果

### Use effect of Metal matrix ceramic insert casting composite Hammer

- under normal conditions, the service life of high manganese steel ceramic insert casting hammer is more than 1 times of that of conventional Mn13 hammer
- the marteniste steel ceramic insert casting hammer is more than 1-2 times of that of conventional Mn13 hammer
- Bimetallic ceramic insert hammer is more than 2 -3 times of that of conventional Mn13 hammer
  
- 正常情况下，高锰钢陶瓷嵌套铸造锤的使用寿命是常规Mn13锤的1倍以上
- 马氏体钢陶瓷复合铸造锤是常规Mn13锤的1-2倍以上
- 双金属陶瓷复合锤是传统Mn13锤的2 -3倍以上



# 高锰钢陶瓷复合轧臼壁使用效果

## Use effect Of High Manganese Steel Ceramic Insert Mantle / Bowl Liner

Cermet insert MANTLE / Bowl liner life comparison table

Material		Mn18Cr2 service life		Mn18Cr2 + Ceramic service life	note
Iron ore	HP500	25days		Over 55days	
Granite	CH660	350-400hour		Over 800hour	
Copper ore	HP4	500-600hour		Over1000hour	
Gold ore	HP300	16days		Over35days	



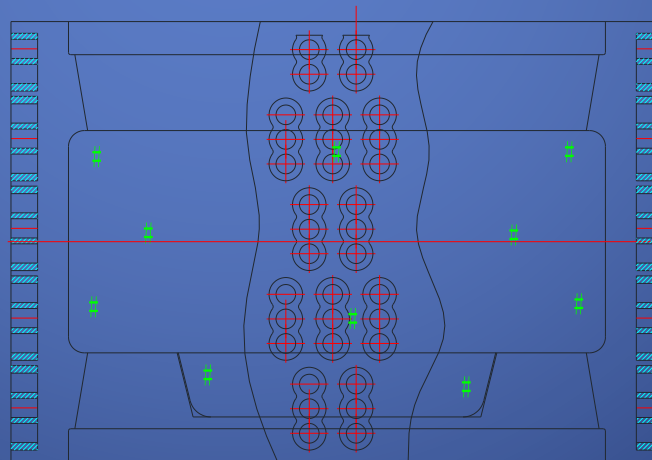


# MMC-SHS 金属陶瓷复合铸造辊压机辊套 使用效果

## Use effect Of Metal ceramic insert composite roller of Rolling machine

辊压机辊套 roller of Rolling machine

Material	铸钉辊 高速工具钢+钨钴钉 9万元/吨	铸钉辊 高速工具钢+TiC钉 6万元/吨	高铬+合金钢双金 属离心铸造 2.8/吨	高锰钢离心铸造 1.8/吨	堆焊辊 4-5个月堆焊一次 可堆焊4-5次 120元/kg	KHD 锻造+钨钴钉 13万元/吨	陶瓷复合辊 5万元/吨
Iron ore	20000hour (3year)						20000hour (3year)
Raw material (limestone)	30000hour (5year)	20000hour (3year)	8000hour	3000hour	4 x 3000hour	20000hour (3year)	30000hour (5year)



## 陶瓷复合耐磨产品包装/颜色 Packaging / Color of ceramic insert casting wearparts

铁托包装，每托重量小于2吨，铸造毛坯表面涂防锈漆，加工表面涂防锈清漆  
Packing with iron pallet (each weight is less than 2 tons)/ Raw casting surface coating anti-rust paint, processing surface coating anti-rust varnish

高铬陶瓷复合铸造耐磨材料 (MMC-Cr)  
High chrome cast iron ceramic insert  
composite wear-resistant castings



合金钢陶瓷复合铸造耐磨耐冲击材料 (MMC-M)  
Alloy steel ceramic insert composite  
wear-resistant castings



高锰钢陶瓷复合铸造耐磨材料 (MMC-Mn)  
High manganese ceramic insert composite  
wear-resistant castings



耐热钢陶瓷复合耐热抗磨材料 (MMC-HT)  
Heat resistant steel Ceramic insert  
Wear/Heat-resistant castings



双金属陶瓷复合 (三相复合) 铸造耐磨材料 (MMC-B)  
Bimetallic ceramic insert composite (three-phase composite)  
wear-resistant castings



●

**谢谢！ / Thanks！**

**Beijing JinMei Entrepreneur Co., Ltd (DJM)**

**Tel: 86-10-8890 9291**

**Mp: 86-13901376361**

**WhatsApp: +86-13901376361**

**Email: info@djm-bj.com leegang@djm-bj.com**

**Web: www.djm-bj.com <https://m.djm-bj.com/m/>**

**北京金煤创业科技股份有限公司**

**北京市石景山区古盛路36号院1号楼14层1403室 邮编: 100043**

**Room No.1403 TaiRan Building, No.36 GuSheng Road, ShiJingShan District, Beijing, China.100043**