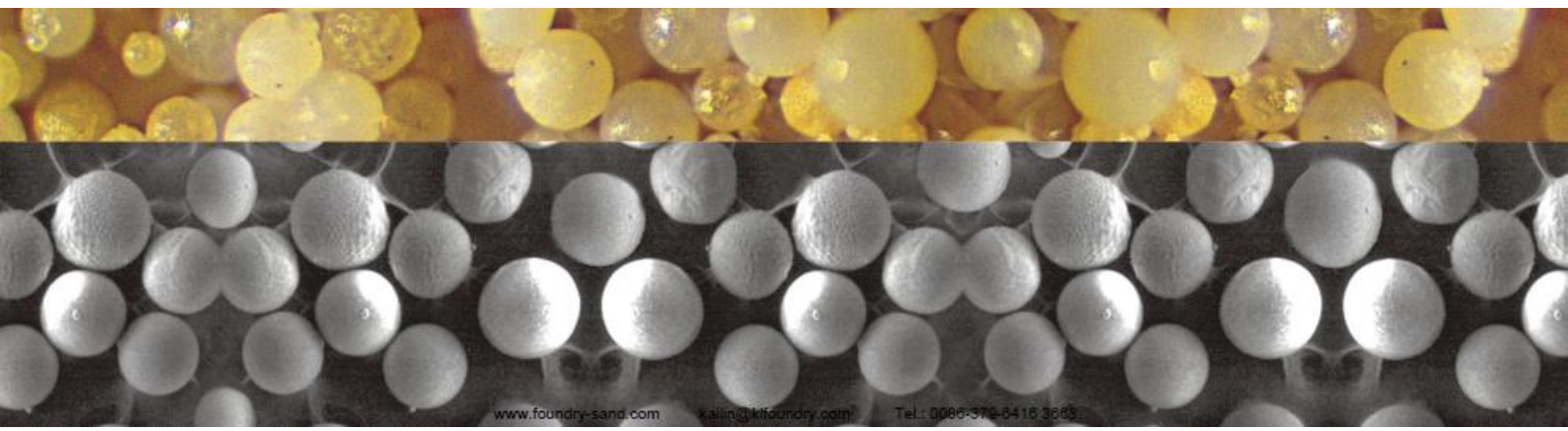


Application of Kailin Ceramic Foundry Sand For Resin Coated Sand

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1. Introduction

Resin coated sand is a commonly used foundry material and a method in foundry practices, it produces castings of high precise dimensions, smooth surface, free of blow holes and devoid of casting defects. It is one of the best molding sands for cars, tractors and hydraulic parts. Resin coated sand is a dry, pre-coated sand mix that is cured by heat. Sand is coated with a phenolic novolac resin along with a hexamethylene tetramine (hexa) cross-linker and other additives specific to the core or mold making process.

Ceramic foundry sand was firstly introduced into foundry industry in 1999 by Luoyang Kailin Foundry Material. Ceramic sand, technically as fused ceramic sand for foundry, is made from calcined bauxite which main content is aluminum oxide, processed by melting, blowing, sieving and blending. Ceramic sand has excellent properties, including spherical shape, high refractoriness, good crush resistance, inert chemical characteristics, high reclamation yields, etc. Ceramic sand has distinguished performance in foundry in compare with silica sand and other popularly used special sands. Therefore, the application of ceramic foundry sand for resin coated sand (RCS) is an innovative highlight and future casting trend.

2. Selection of aggregate for resin coated sand

Aggregate is the main material of coated sand. The requirements for aggregate (raw sand) are: high refractoriness, low volatile content, relatively round particles, and high compressive and impact resistance. Natural scrubbed silica sand is generally used. This is mainly due to its abundant reserves and low price. Under normal circumstances, it can meet customer requirements. Only when there are special requirements for steel castings and iron castings, special zircon sand, chromite sand and other artificial special sand such as ceramic foundry sand are used. The general requirements for silica sand are:

- i. SiO₂ content: for iron castings and non-ferrous alloys, >90%, for steel castings, >97%;
- ii. Clay content: <0.2%;
- iii. Particle size distribution: 3-5 sieve distribution are preferable;
- iv. GFN(Grain Fines Number): different fineness should be chosen according to the casting size and surface roughness requirements, generally AFS50-65;
- v. Grain shape: The raw sand with relatively round grain shape should be used as far as possible, and the angularity factor is less than 1.3;
- vi. Neutral material, pH value is about 7;
- vii. Silica sand needs to be scrubbed with water, if there are special requirements, it needs pickling or high temperature activation treatment (900 °C roasting)

However, With the development of casting technology and various technical requirements, many artificial foundry sands are quickly used in the resin coated sand industry. Among them, the best comprehensive performance and the most common application is Kailin ceramic foundry sand. And the resin coated sand using ceramic sand has more excellent advantages:

- i. **Lower amount of resin addition** - compared to silica sand of the same particle size, to gain the same strength, the amount of resin added is reduced by about 40%
- ii. **Higher refractoriness** - to cast metals with high pouring temperature (cast steel, alloyed cast steel, stainless steel, etc.)
- iii. **High strength and toughness** - to produce more complicated cores with thin sections.
- iv. **Lower thermal expansion** - to avoid expansion defects
- v. **Higher reclamation yields** - to reduce waste sand disposal, in turn to decline costs.
- vi. **Excellent flowability** - to make complicated cores.
- vii. **Inert chemical characteristics** - can applied in any popular alloys, includes Manganese steel.
- viii. **Longer storage period.**

Meanwhile, as artificial sand, Kailin ceramic foundry sand has a wide particle size distribution and is suitable for various casting processes and casting process requirements. When fine sand is used, it still has high air permeability, which is beneficial to improve the surface finish of castings. When Kailin ceramic resin coated sand is applied to iron castings and non-ferrous alloy parts, the content of Al₂O₃ is required to be no less than 70%. When applied to steel castings, especially stainless steel, it is better to have an Al₂O₃ content of no less than 73%.

Regarding the particle size of Kailin ceramic resin coated sand, in general, similar to silica sand, GFN 50-65 AFS base sand, 4 or 5 sieve distribution is used. However, due to the advantages of ceramic sand, in recent years, much finer ceramic sand such as 100/200, 140/200 has also been successfully applied to small steel castings, especially the surface quality of castings is need to be close to investment castings. The following table shows the performance of Kailin Foundry Material Co., Ltd. 50/100 ceramic sand coated sand, which demonstrates high resin specific strength and excellent high temperature performance.

Properties of RCS using Kailin ceramic sand(typical)

Resin addition, %	Tensile strength, MPa	Bending strength, MPa	Thermal bending strength, MPa	Gas evolution, ml/g	Softening point, °C	LOI, %	GFN
1.9	2.8	6.3	2.5	11.3	92	1.8	AFS 58



Water jacket sand core of cylinder head made by Kailin ceramic sand RCS

3. Resin coated sand for shell method

Shell method is one of the most popularly used core (molding) processes of resin coated sand. It has developed rapidly in recent years, especially the Kailin ceramic foundry sand RCS shell process, from the initial bucket teeth of construction machinery in beginning to the general parts such as valves and plumbing, auto parts to tool hardware parts nowadays, from cast iron, cast carbon steel, to stainless steel, heat-resistant steel and non-ferrous alloys, extend to various fields of sand casting, lost foam castings, and investment casting. Kailin ceramic foundry sand RCS shell investment casting process has achieved good economic and social benefits.

From the perspective of casting process, Kailin ceramic foundry sand RCS shell investment casting process has been widely used in the following three fields:

- i. Partially replace some lost wax investment casting process. Especially for some castings with relatively simple shapes and some castings need many cores;
- ii. Where quartz sand shell casting was originally used, Kailin ceramic foundry sand RCS shell investment casting process is used to improve process adaptability;
- iii. In order to improve the quality of castings, reduce the consumption of molding sand, and improve the production efficiency of castings, the small steel castings originally produced by ordinary sand mold technology will use the new Kailin ceramic foundry sand RCS shell investment casting technology, etc.

The relevant parameters may as follow; iron-sand ratio 1:1-4, pattern draft 0.5-1 degree, sand core wall thickness 7-12mm, casting dimensional tolerance CT 7-9 (GB 6414), casting surface roughness Ra 12.5 and lower.

The s Kailin ceramic foundry sand RCS shell process has high dimensional accuracy, good surface finish, high production efficiency, and low solid waste emissions.



Single core piece for shell method (ceramic sand RCS)



Castings clutch with gating system made by shell method



The examples of Kailin Ceramic Foundry Sand Resin Coated Sand for shell investment casting process

4. Conclusion

Compared with silica sand, Kailin Ceramic Foundry Sand Resin Coated Sand has an irreplaceable advantage

- i. Reduce the environmental pollution of coated sand
- ii. Increase productivity
- iii. Reduce the consumption of numerical curing agent
- iv. Improve casting quality
- v. reduce manufacturing cost