

不定形耐火物の低粉塵化技術

Dust Reducing Technology of Unshaped Refractories

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Abstract

Recently, unshaped refractories are widely used in the steel and non-iron industries. We have developed a new dust reducing type of unshaped refractories for improvement of the working environment. The new products have little dust compared with conventional products, and provide good working conditions in the installation field for gunning and so on. These new products are being used by many customers with good reputations.

1. はじめに

近年の環境問題への関心の高まりに伴い、耐火物業界においても環境対策への取り組みが始まっている。耐火物における環境対策は大きく2つに分けることができる。ひとつは、省エネ・省資源・環境汚染物質の削減を目的とする地球環境への対策である。もうひとつは、耐火物の施工や使用における作業環境への対策である。不定形耐火物は、定形耐火物と異なり、その大部分が粉末製品としてユーザーに出荷され、ユーザーの現場にて施工され製品となる。従って不定形耐火物と施工作業は切り離すことができない関係にある。そのため、不定形耐火物の環境対策の中で作業環境への対策は重要な位置を占める。今回、不定形耐火物の作業環境改善策の1つとして低粉塵型の製品を開発したので紹介する。

2. 低粉塵型不定形耐火物

不定形耐火物の大半は粉末材料としてユーザーの現場に搬入され、流し込みや吹付け等の施工が

1. Introduction

With the rising concern over the earth environment, environmental improvement activities have been started in the refractory industry. There are two types of environmental improvements in the refractory field. One is earth environment improvement for the purpose of the reducing environmental pollution material, conserving energy and resources. The other is improving the working environment including the installation and use of refractories. Most unshaped refractories are delivered to the user as half-products, and they become products by being constructed in the user's field, they are different from shaped refractories. Unshaped refractories are closely bound up with installation work. Therefore, the improvement of the working environment occupies an important position in the environmental improvement of unshaped refractories. We have developed dust

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行われる。流し込み施工では、材料のミキサー投入時および混練初期に粉塵が発生する。一部には集塵機を付帯している大型ミキサーもあるが、あまり一般的ではない。また、吹付け施工時も吹付け装置への材料投入時および吹付け時に粉塵が発生する。特に、狭い炉内での乾式吹付けの環境は劣悪で、作業者にとって過酷な作業となっている。粉塵対策として半湿式タイプ¹⁾や湿式タイプの吹付材も開発²⁻⁴⁾されているが、多くの現場では作業が簡便である乾式吹付材が補修用として利用されている。そこで、これら粉塵発生の問題を解決すべく低粉塵型の製品開発を行った。

Fig. 1 に低粉塵型製品と従来品をビニール袋に入れて軽く振った後の写真を示す。従来品は発塵で袋内が濁っているのに対して、低粉塵型はビニール袋が透明に近く、従来品と比較して発塵量が少ないことが分かる。Fig. 2 に実験室での吹付け状況を示す。低粉塵型は従来品に比べ吹付け時の発塵が少なく炉内が非常に確認しやすい。

3. 粉塵発生量の評価方法

従来製品と低粉塵型の粉塵発生量の比較方法を Fig. 3 および Fig. 4 に示す。ガラスプレートを設置した密閉容器の上部から所定量の粉末製品を投入ししばらく放置する。その後、ガラスプレート

reducing products in order to improve the working environment, and in this report, the features of the dust reducing products are described.

2. Dust Reducing Type Unshaped Refractories

Most unshaped refractories are delivered to the user's job site as dry powder materials, and they are installed by casting or gunning. Rising dust occurs where powder materials are input to mixers and at the first stage of mixing in casting. Some user's job sites have a large size mixer with a dust collector, but this is not common. And dust rises when powder materials are charged into equipment for gunning and gunning installation. Especially, the environment for gunning inside a small furnace was severe for workers. The semi-wet gunning method¹⁾ and wet gunning method (Shotcrete) have been developed in order to reduce dust²⁻⁴⁾. But, dry gunning is still used widely as a repair method because of its simple and easy installation procedure. New dust reducing products were developed to solve these dust rising problems of dry mixes.

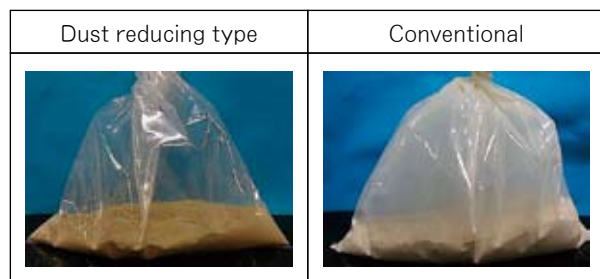


Fig. 1 Dust reducing type mix and conventional type mix in a bag after shake.

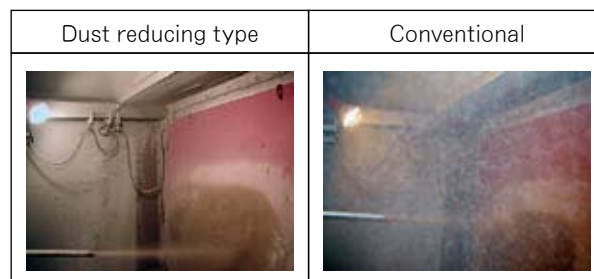


Fig. 2 Comparison of gunning conditions.

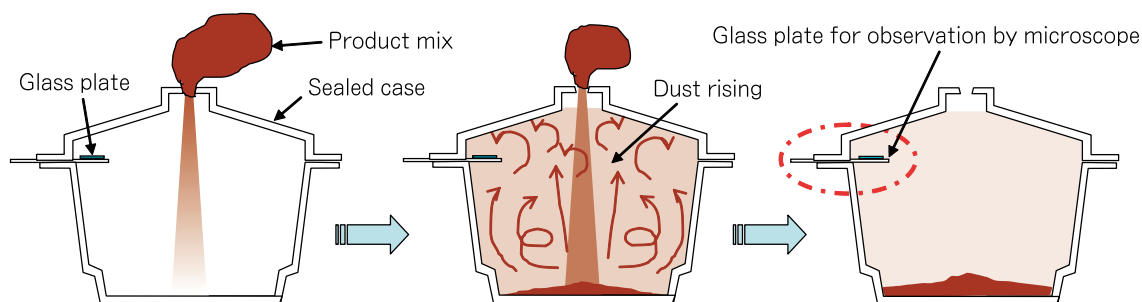


Fig. 3 Test method for dust rising.

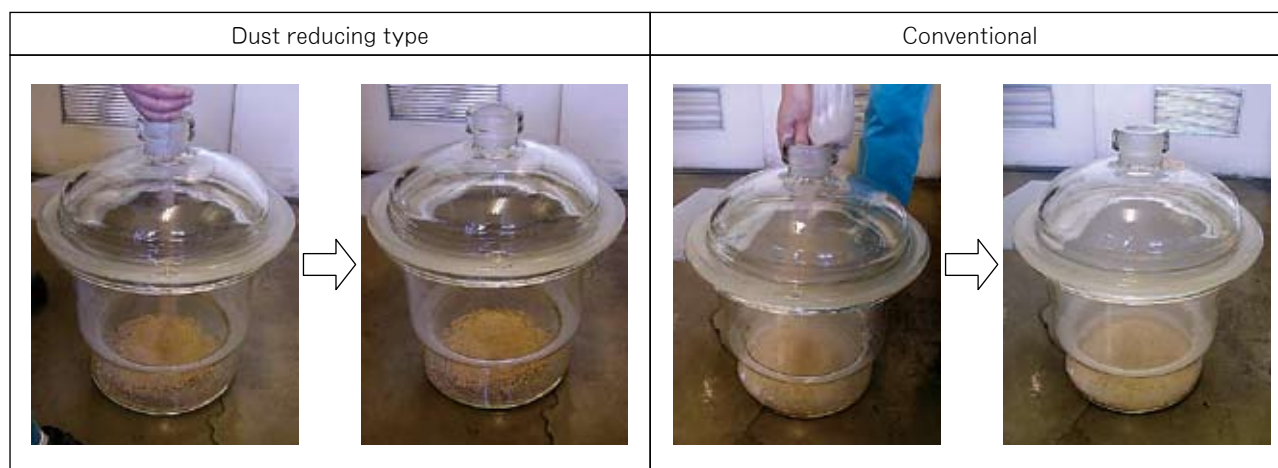


Fig. 4 Conditions of dust rising tests.

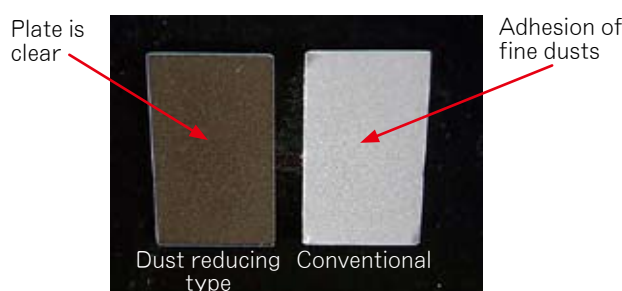


Fig. 5 Surface of glass plates after test.

を回収し、プレートに付着した粉塵を顕微鏡にて観察した。回収したガラスプレートをFig. 5に示す。低粉塵型のプレートは透明に近く、従来品と比較して粉塵付着量が少ないことが分かる。Fig. 6にガラスプレートの顕微鏡写真を示す。低粉塵型の粉塵付着量は従来品の2割以下であることが確認された。これらのことから、実際に低粉塵型製品をミキサーや吹付け装置に投入する際、発塵が大幅に抑制されると判断できる。

4. まとめ

低粉塵型の不定形耐火物を活用することにより、施工環境が改善されると同時に、吹付け施工では吹付け部位が確認しやすい等のメリットが得られる。すでに低粉塵型の製品として電気炉用吹付材、RH浸漬管用吹付材、取鍋用吹付材、汎用流し込み材等が各所にて使用されており、粉塵抑制効果が確認されている。低粉塵型吹付材の品質例をTable 1に示す。これら低粉塵製品は作業環境改善に寄与するだけでなく耐用性においても従

Fig.1 shows the photographs of dust reducing type mix and conventional type mix in a bag after shaking. The dust reducing type mix has little dust in comparison with the conventional one, because the bag in which the dust reducing type mix is in is nearly transparent. Fig.2 shows a comparison of gunning condition in our laboratory. The gunning condition of the dust reducing type mix was clear without dust. That is easy to do gunning than the conventional type mix. And it is good for the working environment.

3. Evaluation Method of the Quantity of Rising Dust

Fig.3 and Fig.4 show the evaluation method for the quantity of rising dust. At first, a glass plate is set in a sealed case. Next, the dry mix is put in the sealed case slowly. Dust rising occurs in the case and dust adheres on the surface of glass plate. After a few minutes, dust on the glass plate is observed by microscope. The surfaces of the glass plates after the test are shown in Fig.5. The conventional type mix has much dust on the glass plate. On the other hand, the dust reducing type mix has very little adhesion of dust, and the glass plate is clear. Fig.6 shows the microscope photographs of the glass plates. It was confirmed that the adhesion amounts of dust of the dust reducing type is no more than 20% that of the conventional type

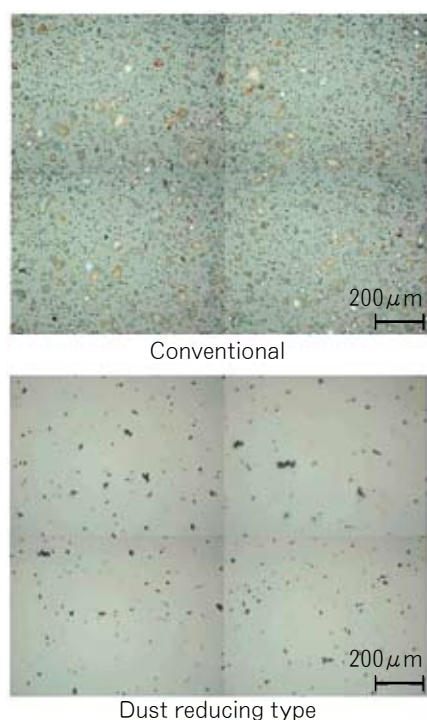


Fig. 6 Microscope photographs of glass plates.

来品と同等以上で推移しており，ユーザーから好評を得ている。今後，さらに低粉塵型製品のバリエーションを拡大していきたい。

mix. Therefore, the working environment of dry mix input to mixer and gunning equipment is improved by application of the dust reducing type.

4. Conclusions

The dust reducing type of unshaped refractory improves the working environment. And in the case of gunning installation, gunning is easy with a clear view in the actual furnace. Gunning repair mixes for EAF, RH degasser snorkels, steel ladles and castables for general-purpose have already been used as dust reducing products in actual furnaces, the dust reducing effectiveness has been confirmed. Table 1 shows the characteristics of the dust reducing type products. These products not only improve the environment but also have better durability than conventional products. They are being used by many customers with good reputations. We want to expand the variations of dust reducing products from now on.

Table 1 Typical properties of dust reducing type products

		A	B	C	D
		Hot repair gunning mixes		Cold repair gunning mixes	
Max. Grain size (mm)		3.0	3.0	3.0	3.0
Chemical composition (%)	Al ₂ O ₃	-	-	87	43
	MgO	88	84	3	-
	SiO ₂	5	6	6	42
Linear change (%)	110°C-24h	-	-	-0.30	0.00
	1000°C-3h	-0.2	-0.15	-0.20	-0.25
	1500°C-3h	-2.0	-0.35	+2.20	+0.50
Modulus of rupture (MPa)	110°C-24h	-	-	1.0	5.9
	1000°C-3h	0.2	2.7	1.5	3.6
	1500°C-3h	2.6	4.4	9.5	8.0
Typical application		For EAF	For RH	For ladle	General-purpose

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