

イソライト工業株式会社

「ファイバー質キャストブル - Fキャスト -」

Isolite Insulating Products Co., Ltd.

“Fiber Castable - F Cast - ”

中 島 幸 次^{*1} 林 和 宏^{*2}
Koji NAKASHIMA Kazuhiro HAYASHI

Abstract

A unique lightweight castable consisting of ceramic fiber and refractory powder has been developed and commercialized by Isolite. The following is a brief description of its properties and typical applications.

1. はじめに

Fキャストは弊社が2000年に開発商品化した製品で、セラミックファイバーと耐火粉末により構成されるユニークな軽量キャストブルである。

主用途は耐スケール抵抗性の特長を生かした連続式加熱炉の水冷管用耐火物であるが、他用途として鍛造炉用耐火物（側壁および天井）やバーナータイル等にも横展開し始めている。

2. 特 長

1) 高耐熱・低収縮率

主原料に高温用セラミックファイバー＋高耐火度粉末を使用，かつ結合材使用量が微量のため耐熱性が高く，熱収縮率も小さい。

2) 軽量・低熱伝導率

乾燥後のかさ比重が1.14で耐火キャストブルの半分程度，これに伴い熱伝導率が3分の1程度と小さい。

1. Introduction

F Cast is a product developed and commercialized by Isolite in 2000. The unique lightweight castable compounded from ceramic fiber and refractory powder is primarily being used for cooling water pipes of continuous heating furnaces making use of its excellent scale resistance. As already seen with forging furnaces (on the side walls and ceiling) and burner tiles, development of further applications is expected to continue.

2. Properties

1) High refractoriness and minimal shrinkage

Because of the use of ceramic fiber and refractory powder as its main ingredients with a very limited quantity of binder, F Cast excels in its high refractoriness and

^{*1} イソライト工業株式会社 エンジニアリング部 課長 Manager, Engineering Department, Isolite Insulating Products Co., Ltd.
^{*2} イソライト工業株式会社 エンジニアリング部 主任 Assistant Manager, Engineering Department, Isolite Insulating Products Co., Ltd.

3) 耐スケール性

耐火キャストブルと同等の耐食特性がある。

4) 作業性

施工方法として流し込みあるいはポンプ圧送が可能のため作業能率が高い。

Table 1 にFキャストの一般品質を示す。

3. 使用事例

1) 加熱炉 水冷管

加熱炉内部にあってスラブやビレット等の荷重を支えるビームおよびポストは一般的に耐火または耐火断熱質キャストブルあるいは「セラミックファイバーの表面コーティング品」が使用されている。しかし前者は耐スケール抵抗性や耐風速性に優れるが熱伝導率は大きく断熱性に劣り、後者は熱伝導率が小さく断熱性には優れるが機械的強度に劣る。Fキャストは従来のキャストブル同様

minimal shrinkage.

2) Lightweight and lesser thermal conductivity

The bulk density of F Cast after drying is 1.14, almost half of refractory castable, thus making its thermal conductivity about a third of refractory castable.

3) Scale resistance

The scale resistance of F Cast is almost equivalent to that of refractory castable.

4) Work efficiency

At the installation, F Cast can be cast by either pouring or pressure-feeding by pump, significantly reducing labor and time.

The properties of F Cast are shown in Table 1.

Table 1 Properties of F Cast

Max. Temperature Recommended [°C]		1500
Bulk Density (after drying at105°C)		1.14
Modulus of Rupture [MPa] (after drying at105°C)		0.8
Thermal Linear Shrinkage [%] (after firing at1500°C)		1.6
Thermal Conductivity [W/(m・K)] (at350°C) {kcal/m・h・°C}		0.26 {0.22}
Chemical Composition [%]	Al ₂ O ₃	70
	SiO ₂	28
Water Rate Recommended [%]		48~50
Quantity Required [ton/m³]		1.1



Fig.1a Insulating Castable



Fig.1b Ceramic Fiber Module



Fig.1c F Cast

Table 2 Comparison of Heat Transfer From Post

	Refractory Castable	Insulating Castable	Ceramic Fiber Module	F Cast
PIPE(I.D) [°C]	35.2	34.0	31.2	32.4
PIPE(O.D) [°C]	38.1	36.2	31.9	33.7
Amount of Heat Transfer [kJ/m]	33,690 (100%)	25,960 (77%)	7,820 (23%)	15,600 (46%)



Fig.2a Wall



Fig.2b Around Burner



Fig.2c Roof

3. Applications

1) Cooling water pipes of continuous heating furnaces

In the inside of heating furnaces, beams and posts sustaining the load of slabs and billets are normally insulated with materials such as refractory castable, insulating castable, or surface-coated ceramic fiber. However, the former two materials are superior in its scale and velocity resistance but inferior in its insulation efficiency while the latter is superior in its lesser thermal conductivity and insulation efficiency but inferior in its mechanical strength. F Cast is superior both in its scale resistance and lesser degree of thermal conductivity. Fig. 1a, 1b and 1c show the comparison of the conditions of beams in hot strip heating furnaces where different materials were applied. Table 2 shows a comparison of heat transfer from 100mm-thick posts coated with different materials. (temperature inside the furnace : 1350 °C , temperature of cooling water : 30°C, OD and ID of the cooling water pipes : 0.116mm and 0.106mm respectively)

2) Forging furnaces (on the side walls and ceiling)

Insulation materials for forging furnaces are required to be high-temperature tolerant and highly scale resistant. For this reason, refractory castable or refractory plastic has been used on their inner surface while a combination of lightweight castable and

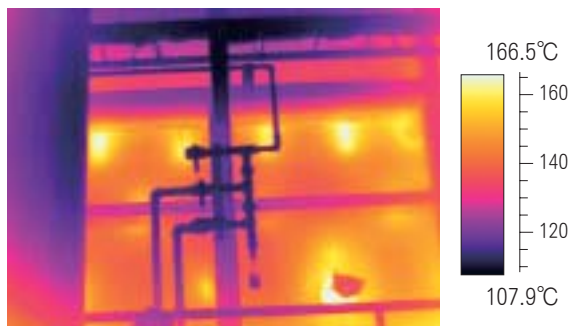


Fig.3a Wall (Before)

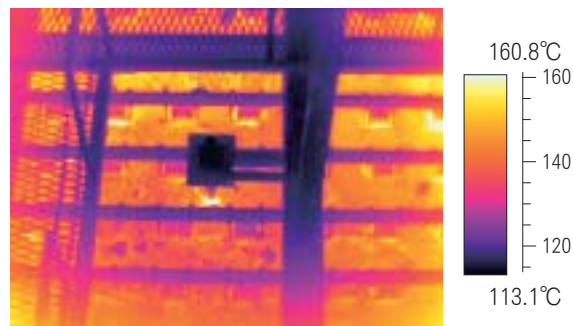


Fig.3c Roof (Before)

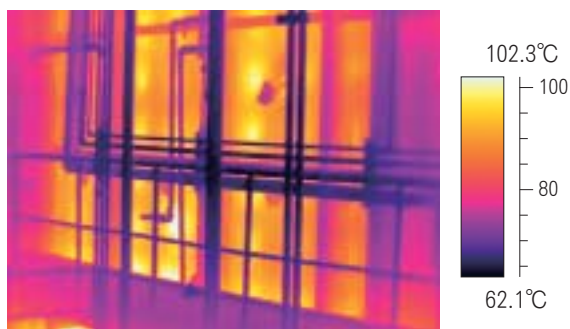


Fig.3b Wall (After)

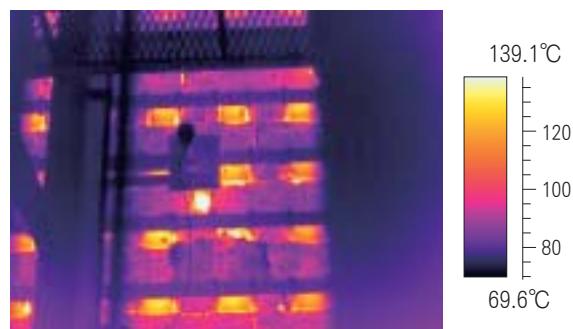


Fig.3d Roof (After)

の耐スケール抵抗性を有し、かつ熱伝導率低減に寄与している。熱延加熱炉ビームにおける各材料の稼働状況（稼働3年）をFig.1a～1cに、耐火物厚み100mmの場合のポストからの伝熱量の比較（炉内温度：1350℃，冷却水温度：30℃，水冷管外半径：0.116mm，水冷管内半径：0.106mm）をTable 2に示す。

2) 鍛造炉 側壁・天井

高温かつ高耐スケール抵抗性が要求される鍛造炉の耐火物構成においては、一般的に表層は耐火キャストブルまたは耐火プラスチック，裏層は軽量キャストブル＋断熱ボードが採用されている。Fキャストは表層用耐火物としても充分使用可能なため，断熱強化による省エネを可能とする。各部位における状況（稼働1ヶ月）をFig.2a～2cに，耐火物改修前後のケーシング熱画像をFig.3a～3dおよび1サイクル（1230℃：24時間保持）の省エネ効果の比較をTable 3に示す。

3) バーナータイル

バーナータイル用耐火物には一般的に高強度・高耐火性を重視した耐火キャストブル製の製品が大半を占め，一部で高断熱・軽量を重視したセラ

insulating boards has been used on their reverse side. With its superior properties, F Cast replaces conventional materials for use on the inner surface and realizes greater energy savings through the increased insulation. Fig. 2a, 2b, and 2c show the condition of the wall, burner section and roof of a forging furnace where F Cast was used. (one month after operation) Fig. 3a, 3b, 3c, and 3d show a comparison of thermal images of a casing before and after repairing with F Cast. Table 3 shows a comparison of energy savings before and after the repairing. (one cycle, 1230℃ kept for 24 hours)

3) Burner tile

Refractory castable has been mostly used in the burner tile sections of furnaces in view of its high strength and high refractoriness while the use of ceramic fiber module products in view of their high insulation and weight reduction has been rather limited. F Cast has intermediate properties between

Table 3 Comparison of Energy-saving Effects

	Before	After
Location : Wall		
Structure of Refractory		
1st Layer [mm]	Refractory Castable [175]	F Cast [100]
2nd Layer [mm]	Insulating Fire Brick [115]	Insulating Castable [150]
3rd Layer [mm]	Insulating Board [60]	Insulating Board [100]
Total Heat Loss [kJ/m ²]	629,100 (100%)	259,200 (41%)
Location : Roof		
Structure of Refractory		
1st Layer [mm]	Refractory Castable [180]	F Cast [200]
2nd Layer [mm]	Insulating Castable [120]	Ceramic Fiber Blanket [100]
Total Heat Loss [kJ/m ²]	535,000 (100%)	281,300 (53%)

ミックファイバー成形品が使用されている。Fキャスト製バーナータイルはこれらの中間的な物性を持ったため、現在その使用可否について実炉テスト中である。

4. おわりに

Fキャストは今年で開発から7年目を迎える。当初に比べ使用範囲も拡大し、生産量も年々増加傾向にある。今後はより顧客に満足していただけるよう、当面の課題であるバリエーションの追加に注力していきたい。

refractory castable and ceramic fiber module products. For making best use of those properties, we strive to expand the range of applications.

4. Conclusion

Seven years have passed since the introduction F Cast into the market. During these years, we have seen both the development of new applications and the growth of production. We aim to serve our customers better by adding further variations to the applications.