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## Development of tundish coating mix with excellent drying and dismantling properties

After relining with a coating mix, the tundish is usually preheated quickly. In order to prevent incidents caused by quick preheating, such as explosive spalling, adequate drying properties are provided to the tundish coating mix by blending fibre. We have established a technique for blending large amounts of fibre in order to accomplish a reduction in thermal conductivity of coating mix of roughly 40%. By utilising a fibre blending technique for the tundish coating mix, gunning and trowelling coating mixes with improved drying properties and dismantling properties were developed.

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The tundish used in continuous casting operations is an intermediate vessel which transfers molten steel from the teeming ladle to mould. It has the roles of storing molten steel temporarily, distributing molten steel to each mould at a stable supply rate and promoting floatation / separation of

non-metallic inclusions. As schematically illustrated in Figure 1, the permanent brick back lining, brick or castable refractory wear layer and coating mix composed of MgO are relined in sequential order in the tundish. Due to the necessity for removing the remaining molten steel and slag after continuous casting →

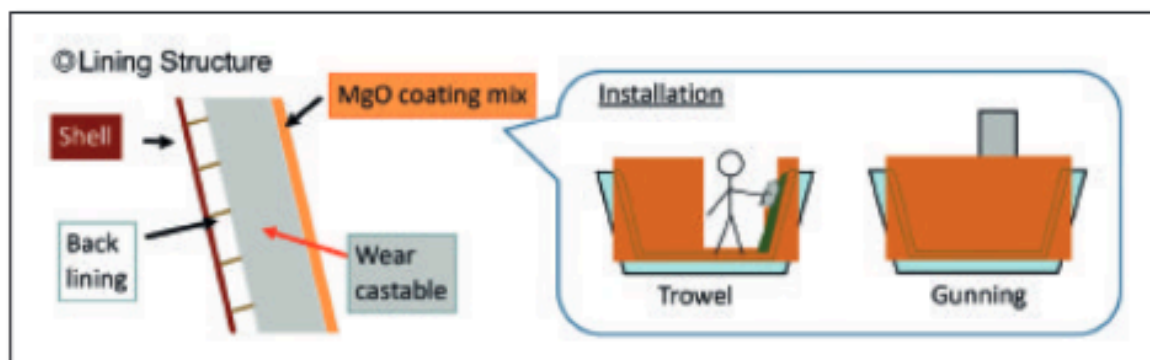


Fig 1 Tundish refractory relining specifications and two coating mix application methods

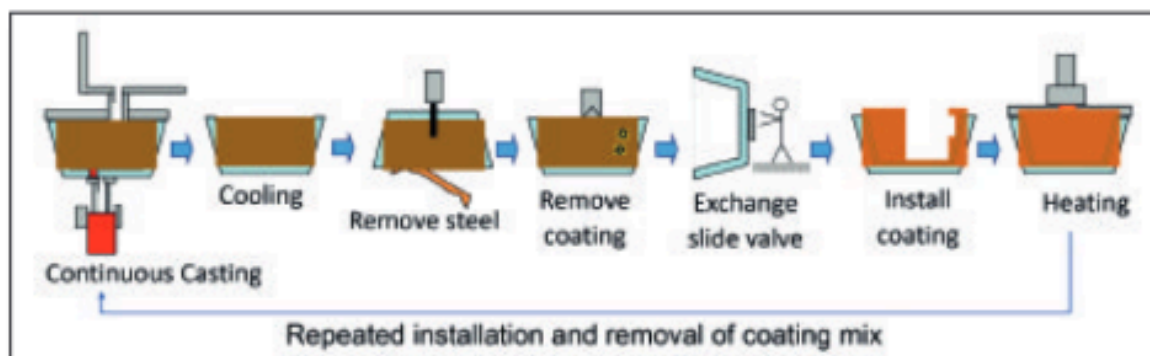


Fig 2 Operation cycle of tundish

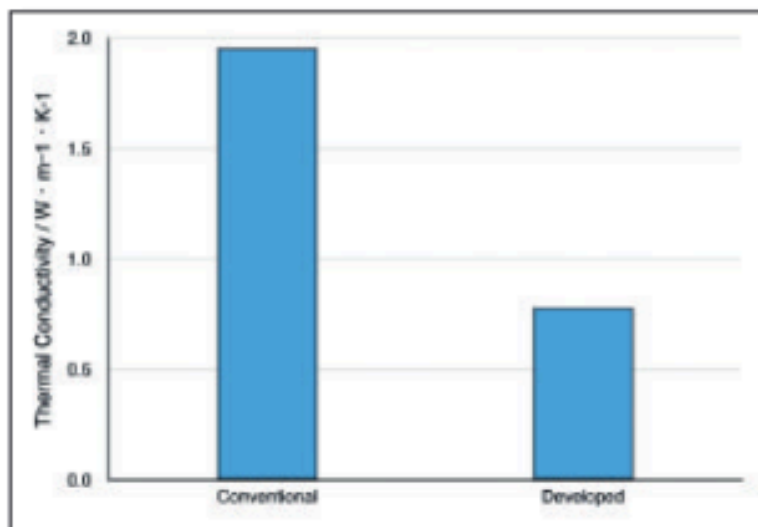


Fig 3 Comparison of thermal conductivity of gunned coating mix body at 1000 °C

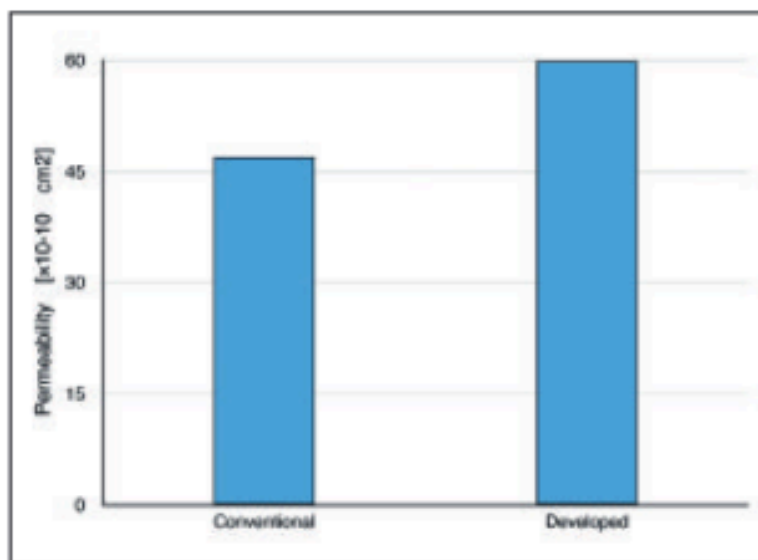


Fig 4 Comparison of permeability of gunned coating mix bodies

operations, a sacrificial coating mix is relined on the working surface of the wear layer refractory so that the remaining molten steel can easily be removed without damaging the wear layer refractory. The coating mix, which is generally composed of MgO in order to secure clean molten steel in the tundish, is relined by gunning or trowelling before every casting campaign. Required properties of the tundish coating mix are cited as: (1) good drying property for quick preheating operation without incidents such as explosive spalling, (2) adequate workability for relining operation, and (3) easy dismantling property with minimised sticking to the wear layer

refractory. Newly developed tundish coating mixes, JTM-M-629 (gunning) and SCOAT-M-71 (trowelling), which have the required properties, have been appropriately developed and improved, and these are introduced in this article.

### TUNDISH COATING MIX

The operation cycle of the tundish is shown in Figure 2. After completion of continuous casting, the coating mix is dismantled, usually along with removal of the remaining metal in the tundish. After a cycle of tundish refractory maintenance work, the coating mix is applied to the lining again. Before use in continuous casting operations, the tundish is preheated quickly. In order to prevent explosive spalling during quick preheating, fibre is generally blended in to the mix to ensure permeability of the relined coating mix body. When large amounts of fibre are blended, however, transportation efficiency of the coating mix is reduced in the gunning operation, resulting in an unstable gunned coating mix body. When large amounts of fibre are blended into the trowelling coating mix, the trowelled coating mix tends to slip down because of insufficient adhesiveness. That is, fibre blending technique which includes selection of appropriate fibre material and/or fibre shape is quite important to suppress/minimise negative influences of fibre blending on coating mix properties. By utilising an elaborately improved fibre blending technique, new coating mixes, JTM-M-629 (gunning) and SCOAT-M-71 (trowelling), were developed. Features of these coating mixes are introduced in the following sections.

### GUNNING COATING MIX: JTM-M-629

The thermal conductivity of the newly developed coating mix, JTM-M-629, at 1000 °C is shown in Figure 3. Compared with a conventional coating mix, by blending large amounts of fibre, the gunned body structure of the newly developed coating mix becomes more porous, resulting in reduction of thermal conductivity at 1000 °C by roughly 40 %. Since, because of lower thermal conductivity, the temperature at the interface between the wear layer refractory and coating mix is lowered, sticking of the coating mix to the wear layer refractory is suppressed. As shown in Figure 4, in which permeability of the gunned coating mix body is compared between

		JTM-M-629	SCOAT-M-71
Chemical composition /%	MgO	87	88
	SiO <sub>2</sub>	5	5
Permanent linear change /%	1000°C-3h	-0.01	-0.30
	1500°C-3h	-3.48	2.97
Modulus of rupture /MPa	110°C-24h	1.2	1.5
	1000°C-3h	0.8	1.9
	1500°C-3h	4.4	5.7
Added amount of water /%		18-22	15-18
Installation weight per unit volume /kg·m <sup>-3</sup>		1,900	1,900
Notes		Gunning mix	Trowelling mix

Table 1 Typical characteristics of gunning and trowel coating mixes

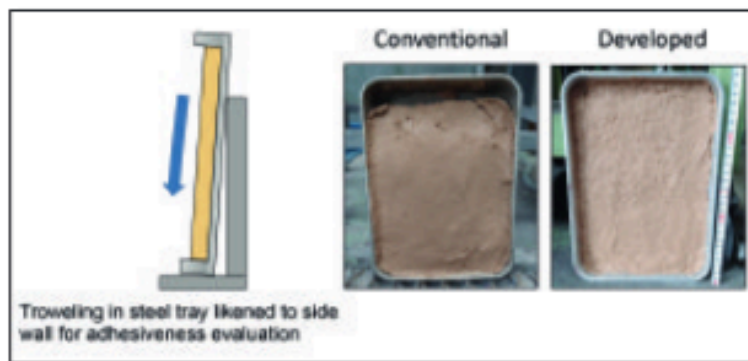


Fig 5 Test method for evaluating adhesiveness of trowelling coating mix

the conventional and developed product, large amounts of fibre blending contributes to improvement of permeability of the gunned coating mix body. It is inferred that improved permeability of the gunned coating mix positively influences suppression of explosive spalling. It is noted that, despite the large amount of fibre blending, transportation efficiency of the developed coating mix during gunning operation has been adequately achieved by the improved fibre blending technique.

#### TROWELLING COATING MIX: SCOAT-M-71

Similar to gunning coating mix, JTM-M-629, large amounts of fibre are blended into the newly developed trowelling coating mix, SCOAT-M-71, in order to suppress sticking to the wear layer refractory. In addition, shape retainability of the relined coating mix body, ie, workability in trowelling operation without slumping has been realised by using an additive agent with high viscosity and quick setting characteristics.

Figure 5 shows the test method for evaluating the adhesiveness of the trowelling coating mix and illustrates the appearance of conventional and developed coating mix which has been trowelled in a steel tray. The coating mix was

trowelled in a steel tray set up at 80 degrees of tilt angle to liken it to a tundish side wall for evaluating workability and adhesiveness. As is observable by the appearance of the trowelled coating mix bodies shown in Figure 5, the newly developed coating mix exhibits almost no slip-down in its relined body, namely, better shape retention and adhesiveness.

Typical characteristics of the newly developed gunning and trowelling coating mixes are summarised in Table 1. Both coating mixes are composed of magnesia and have been used in both integrated steel plants and electric furnace steel shops with good results and reputation.

#### CONCLUSION

By establishing a fibre blending technique for the tundish coating mix, gunning and trowelling coating mixes with improved drying, workability and dismantling properties were developed. These coating mixes have been used in practical operation with good reputation for their performance. **MS**

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