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BF Cast House Refractory - Trough Mix

SPECIFICATIONS						
Properties		Index	Category			
			SINEW Apool	SINEW Amain	SINEW Aslag-run	SINEW Aswing
Chemical compositions (%)	≥	Al_2O_3	55	72	55	72
		SiC	35	10	15	10
Bulk density (g/cm^3)	≥	110 ^{0}C x 24h	2.60	2.90	2.50	2.90
		1450 ^{0}C x 3h	2.70	2.85	2.50	2.80
Cold modulus of rupture (MPa)	≥	110 ^{0}C x 24h	4	5	4	5
		1450 ^{0}C x 3h	4	7	5	8
Cold crushing strength (MPa)	≥	110 ^{0}C x 24h	20	25	20	35
		1450 ^{0}C x 3h	30	40	30	70

The tapping rate, temperature of pig iron and duration of tapping have increased considerably in a modern blast furnace resulting in stringent service conditions for troughs/runners. Thus the conventional hydrous mass or **Al_2O_3-C** mass is no longer adequate to survive the stringent operating conditions. In trough the wear process starts with corrosion but erosion and cracking also come into play. While corrosion could be tackled by chemical properties of material, the process of erosion and cracking could be eliminated by proper engineering of the physical properties of the material.

Al_2O_3-SiC-C material, which has excellent corrosion resistant, has been accepted as a standard base material for wear. As regards to physical characteristics, some design and engineering need to done in the material, as under.

The wear lining must show a slight positive expansion over the entire range of their working temperature. Also, during cooling there must be an overall 'leftover' positive expansion in the trough. Under this condition the wear lining material will not show any crack and slow penetration of hot metal at localised places can be stopped. To accommodate the expansion, avoiding any bulging out, expansion allowances need to be provided by way of inserting compressible high temperature material in the wear lining near the blast furnace shell. The safety lining surface should be smooth enabling main lining to slip over it, during expansion.

On many occasions, due to operational constraints a trough is cooled down after drainage and hence working lining temperature falls down to ambient temperature. In such a situation, a negative **PLC** (permanent linear change) value of material will allow for cracks opening in the lining which again will not seal up during heating. These cracks would be vulnerable areas of attack during subsequent running of trough. Hence, the **PLC** value of material at operating temperature should be slightly positive or material should be volume stable.

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Both tensile and compressive hot strength of the material should be high. While the high tensile strength takes care of any crack initiation tendency, the compressive strength determines rate of erosion of wear lining by flowing iron & slag streams at high temperature. Addition of fine powders of **Si, Al** and **Mg** to the extent of 1- 5% helps in improving these hot strengths of the material.

Thermal conductivity is very important in a 'pooling type' trough where due to long stretch of iron holding continuously, refractory lining reach almost steady state of thermal equilibrium. High value of thermal conductivity would convey more amount of heat to safety lining and supportive structure. In the absence of cooling of trough (i.e. trough embedded) in cast house with no external face exposed to any cooling, the increased amount of heat evacuation to supporting structure would cause the back up lining temperatures to go up thereby damaging supporting structure and also the movement behind wear lining would cause cracks in wear lining. However, if the trough is a cooled one, the higher thermal conductivity of both wear and back-up lining is desirable, so that the temperature gradient at hot face could be kept steep containing the wear factors.

Our trough mixes imbibe in themselves all the aforementioned, desired properties, for exhibiting **SINEW** strength, when put in the most stringent service conditions of the modern blast furnaces.

Installation Techniques - Trough Mix

The trough mix is rammed 'in-situ' by a pneumatic rammer, into a monolithic structure. The simplicity of installation makes it a commonly used material for trough lining. Heating schedules need to be closely monitered to avoid any cracking or spalling during heating. The trough should be heated up slowly so that no thermal stress develops to cause spalling of the trough. A faster rate can be adopted for heating the trough after repair work. Proper precautions taken during installation and subsequent heating can extend the service life immensely.

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