TATA METALIKS

TATA

PRAYAS

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DEAR CUSTOMERS,

It gives me great pleasure to connect with you through our technical newsletter **PRAYAS.**

It is our endeavour to foster long term relationships with our customers by not just delivering high quality Pig Iron but also providing technical assistance through our Customer Service Centre (CSC). 'PRAYAS' is a small effort in this line, published by our CSC to enforce our commitment to you. We also intend to share our internal process of raw material procurement through this newsletter in order to advance your confidence level for uninterrupted supply as per required quality at an optimum price.

In the Pig Iron business, raw material plays a very important role both in terms of quality & cost. In order to maintain consistency in chemistry & optimize cost, we give utmost importance to raw material procurement. Strategic procurement of raw material ensures supply chain security through global supply network & strategic contracting.

The Supply Chain Management process follows various key steps to maintain raw material quality & optimize cost. Robust vendor registration process, procurement through approved vendors, vendor performance rating & feedback, vendor satisfaction survey, suppliers' meet, flexible coke sourcing model, pre-despatch inspection, robust contract management, alternate source development and value in use study are few of the key steps we follow to ensure quality, cost competitiveness & timely delivery.

Additionally, iron ore linkage with Tata Steel ensures sustainable operation & procurement of fluxes from overseas suppliers improves quality of input material. Continuous evaluation of market has given us the ability to obtain information on changing market conditions & fine tune our decision-making ability. We are on a continuous journey of upgradation to provide our customers with superior quality of products and services.

We are hopeful that our effort through 'PRAYAS' will help in building a sustainable business relationship with our customers.

Yours Sincerely,

Saradindu De
Chief - RM Procurement & Logistics

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EDITORIAL

Dear Valued Customers,

In the interlinked foundry processes, procurement of pig iron and melting processes play very important role in achieving the targeted quality and performance of the foundry. The quality of castings produced depends on pig iron quality which in turn depends on the raw materials through which it was manufactured in the blast furnace.

Raw Material Sourcing Strategies are critical to revenue and profit margins. The strategies we adopt in sourcing raw materials to maintain quality and steady supplies are described in a key note message by our Chief - RM Procurement & Logistics. These strategies are giving results for raw material supply, security and in turn supply of pig iron of right chemistry, 24x7 to customers.

Cupola is the most commonly used furnace for making Grey Cast iron throughout the world. Although other types of furnaces are also used, by far the highest tonnage of Grey Cast iron is produced through cupola. The operation of cupola looks simple, but there is a higher number of variables in cupola operation in comparison to other melting furnaces. For example, humidity of air, size of raw material & consumables, charge mix, coke to metal ratio etc. In this issue of PRAYAS, we have highlighted some salient points of cupola operation for energy efficient operation to save coke, to run the cupola smoothly throughout operation, to reduce CO_2 and CO emissions thus contributing to reduced carbon footprint and for achieving higher melting rate and temperature with optimum coke consumption.

We hope that this issue would enrich your cupola knowledge and inspire you to make changes in your furnace operation that will benefit both you and the environment. For more details and assistance on "Energy efficient operation of your cupola", contact our Customer Service Centre team.

Advance Durga Puja wishes from TML family.

Regards,

M Sambasiva Rao and Sukhendu Mukherjee.

Editorial Team:

M Sambasiva Rao, Sukhendu Mukherjee, Munmun Pal and Nidhi Pugalia.

ENERGY EFFICIENT CUPOLA OPERATION

Cupola is the most common type of melting furnace used in foundry industry and is employed for melting and refining of pig iron along with scrap in the production of iron castings. This furnace has many distinct advantages over the other options, such as simplicity of operation, continuity of production, economy of working and increased output.

Heat, carbon dioxide (CO_2) and carbon monoxide (CO) are released through the following reactions by the combustion of coke.

1. $C + O_2 = CO_2$ Exothermic reaction (heat generated)

2. $CO_2 + C = 2CO$ Endothermic reaction (heat absorbed)

In a divided blast cupola (DBC), reaction (2) i.e. generation of CO is suppressed by introduction of air through secondary (upper) row of tuyeres, about a meter above the primary (lower) tuyeres.

A properly designed and operated DBC has the following benefits:

- Lower coke consumption by 15 to 20 %
- Increase in tapping temperature by about 50^0 C
- Higher melting rate for the same internal diameter (ID) of the cupola

MELTING RATE

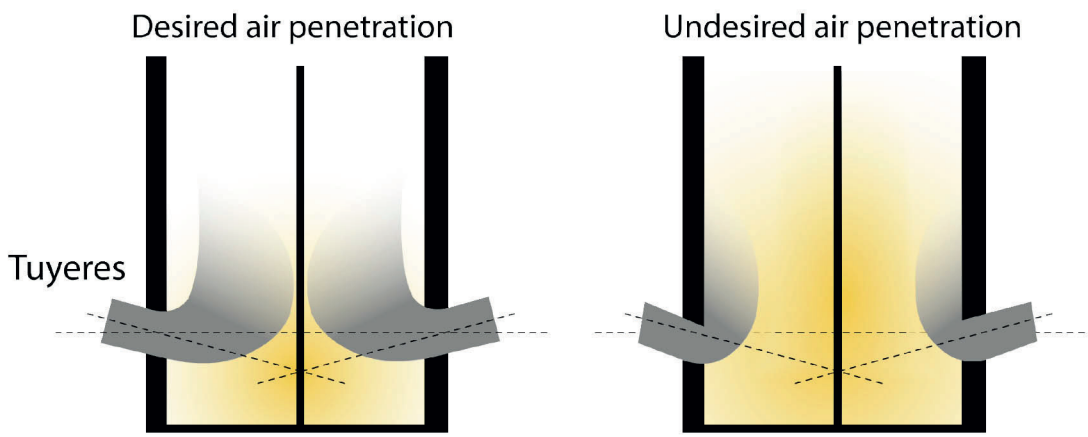
The melting rate of a cupola depends on the coke ash %, blast rate and blast pressure. The blast rate and pressure have important influence on cupola performance.

BLAST RATE

Blowing rate should be 15 to 20% more than the optimum blast rate, to account for air losses in the pipeline. Cupola should not be over-blown. A higher blast rate increases oxidation loss of iron and other elements like silicon and manganese. A lower blast rate leads to lower metal temperature, slower melting and higher coke consumption.

BLAST PRESSURE

Proper blast pressure is required to penetrate the coke bed. Incorrect air penetration affects the temperature, carbon pick up and the melting rate of the cupola. Incorrect and correct penetration of blast air is shown in the figure below.



STACK HEIGHT & WELL CAPACITY

Consider increasing stack height of the cupola. A stack height of 15 to 24 ft. (depending on its internal diameter) is necessary for heat exchange. Inadequate stack height leads to lower heat exchange, lower metal temperature at spout and higher coke consumption.

Do not increase well capacity more than what is desired. Every inch increase in the well depth reduces molten metal temperature by 4^0C. For intermittently tapped cupola, the well capacity should match the capacity of the ladle and for continuously tapped cupola, a minimum well depth, ideally one foot (12”) is usually sufficient.

REFRACTORY LINING

Use IS 8 grade fire bricks for lining the cupola. For double layer lining, IS 6 grade bricks can be used in the rear side towards cupola shell. Do not use cracked and corner chipped bricks in the melting zone. Store the fire bricks in a covered area to keep them dry. Bricks should be set 15 to 20 mm away from the cupola shell. The gap should be packed with dry foundry sand. Cupola must be properly lined/repaired after each melt. Correct internal diameter (ID) needs to be maintained.

COKE BED PREPARATION

Check cupola sand bed for correct sloping towards the tap hole. Put dry fire wood on the sand bed for igniting. Large pieces should be avoided and firewood should be carefully placed. to avoid sand bed damage. Coke bed should be charged part by part and not in one go, to avoid improper burning. Never use burnt coke.

Coke bed height is defined as the height of coke, above the top tuyeres. The coke bed is added to the cupola furnace in three stages:

First stage: The first stage coke quantity is calculated by multiplying the distance between sand bottom to centre of first row of tuyeres in feet with weight of coke with 12" well. It is added on the fire wood which is used to ignite coke.

Second stage: After the first stage coke is ignited, add the second stage coke. The second stage coke quantity is calculated by multiplying the distance between centre of first row of tuyeres to centre of second row of tuyeres in feet with weight of coke with 12" well.

Third stage: The third stage coke quantity is calculated by multiplying the calculated coke bed height with weight of coke with the 12" well.

To measure the height of coke bed, a chain/rod should be used from charging door sill (bottom) to ascertain the correct height. If needed, some fresh coke is added to replenish the burnt out coke and to have desired height and level.

CHARGE MATERIAL, SIZES & SEQUENCE

Charge material should be clean. Excess oil, rust and dirt clinging to charge material will require more flux material & coke and also lead to greater erosion of cupola lining. Correct weighing of charges is very important for proper and stable chemistry of the molten metal.

Size of coke for energy efficient operation, should be 1/10th to 1/12th of internal diameter of cupola.

Flux (limestone) size should be 0.75" to 2".

Metallic charge should be less than 1/3rd of the cupola ID.

Charging sequence inside the cupola should be coke, limestone and metal (Ferro Alloys to be charged on the limestone) and always charge steel scrap near the coke.

CUPOLA OPERATION

After blowing on, first tapping can be made approximately between 18 to 22 minutes. The required chemical composition depends on proportion of pig iron, C.I scrap, foundry returns, steel scrap and Ferro alloys. With the start of melting, the charge in stack starts descending and one should be careful to ensure that there is no hang of charge. Keep on charging and keep the charge full up to the charging door. Bridging or hanging affects the quality and chemistry of molten metal.

The factors determining air volume and pressure are size and type of cupola, melting rate required, coke to metal ratio, chemistry of iron, temperature of iron at spout, height of coke bed & charges above tuyeres and size & quality of coke.

The slag's ideal colour should be bottle green and colour changes from blackish to black depending on higher oxidation level, loss of various elements and decrease in coke bed height.

INSTRUMENTATION

A foundry should have at least the following instrumentation for energy efficient cupola operation:

- Air pressure gauge
- Blast volume meter
- Weighing scale for weighing charges
- Coke bed height gauge
- Immersion type pyrometer to measure temperature of molten metal
- Carbon equivalent meter

SAFETY PRACTICES

- Scrap in the form of closed hollow vessels should be broken open before charging to prevent explosion in cupola.
- A guard rail across the charging opening should be provided.
- In divided blast cupola, for any temporary shutdown, close the valve of upper tuyeres and do not allow any gas (mainly CO) to accumulate in the tuyeres which may create explosion when it reacts with oxygen of the air blast.
- Personal Protective Equipment such as safety shoes or foot guards, leggings, gloves, cup type goggles and helmets should be used.
- Any spattering of molten metal during botting of tap hole should be avoided by maintaining a downward sharp angle.
- During dropping of the bottom, nobody should be allowed inside the danger zone unless

Mr. Mohit Beriwal
Director
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CUSTOMER'S VOICE

We would like to convey our gratitude and appreciation to the team of Tata Metaliks for their everlasting support and cooperation, especially the Technical/Quality team and the Marketing team.

Mr. M.S.Rao from the Technical team, in particular, has always been prompt with responses and assistance on matters related to quality of castings, critical in nature to us. He has guided us time and again on matters related to chemical and physical aspects of castings and helped us improve our quality, especially with regard to the melting process.

As regards to the Marketing team, we have always received cooperation from them in terms of constant and ready supply of pig iron irrespective of the market conditions, which has helped us in fulfilling our orders with our customers consistently. Mr. Devraj Choudhary, in particular, has always assisted us with timely delivery of materials and working out quantity security of raw materials which has gone a long way in enabling us to fulfill our orders with our clients.

We sincerely hope that this cooperation will continue in the times to come and our partnership bond with Tata Metaliks will only grow stronger.

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