Course Material

EFFICIENT INDUCTION MELTING PRACTICE

This is a older version of technology paper. There are some changes which will be indicated during the program presentation.

All are aware that the Melting Shop is an important department of any foundry. Now a days it consists of med. frequency Induction Furnace. This melting shop spends 40% to 60% of casting price. Contribution is from pig iron, scrap, ferroalloys & electricity. Controlling cost in melting dept is very necessary.

Factors which are controlled by market, like price of raw material (scrap, alloys, electricity, etc) are not in the foundrymen's hand.

Foundrymen can control/reduce cost at various stages. Few of them are as under.

1) Selection of Induction Furnace.(KW rating, capacity of furnace, Hz, etc)
2) Working hours on induction furnace.
3) Producing more metal in minimum time.
4) Operating furnace on min Kw to minimise M.D.charges.
5) Avoid holding of metal.
6) Minimise chemistry adjustment time.
7) Empty out the Furnace as fast as possible.

Refractory Materials

Silica (SiO_2) ramming mass, Boric acid (binder), Corundum (Al_2O_3) and Magnesite (MgO)

1. They have to withstand high temp. retain their strength and also take part in chemical reaction.
2. Acidic refractories contain high Silica
3. Basic refractories are Magnesite.
4. Acid slags have high silica content and do not react with acidic refractories.
5. Basic slag furnaces viz. for steel are lined with magnesia.
6. Induction furnaces for iron melting are lined with silica ramming mass. It is mixture of crushed quartzite – silica grains from 0 to 4 mm and 0 to 6 mm and boric acid as the binder.

Special refractory castables are used in the furnace bottom. The coil is grouted with refractory cement.

Magesite linings are used for high alloy steels.

Fluxes are low melting materials. These mix with sticky, viscous furnace slags, sand, earth materials, metallic oxides etc and convert them into easy flowing slags.

Silica Ramming Mass

It is made from crushed quartzite. It should be clean and without any binder. SiO_2 should be above 98.5%. It should be amorphous and be crystalline which can be checked under polarized light. Colour should be snow-white

Grain Size

The more compact a lining, the greater the strength and life. The packing density depends upon the proportion of grains of different sizes that will give the least open spaces between grains (particles).

Standard Mix

Particle Size	Sieve Opening mm	Mesh Nos.	%
Coarse	0.6 and above	+ 20	45
Medium	0.2	65	10
Fine	0.2	150	20
Extra fine	Fine	- 150	25

Preparing The Ramming Material

The ramming material is dried on a heated tray of sheet metal at about 120^{o}C. It is then cooled to below 60^{o}C and mixed with boric acid powder in a concrete mixer. Approximately 0.8 to 1.2% boric acid is used as binder, for the melting temperature of 1450 to 1550^{o}C.

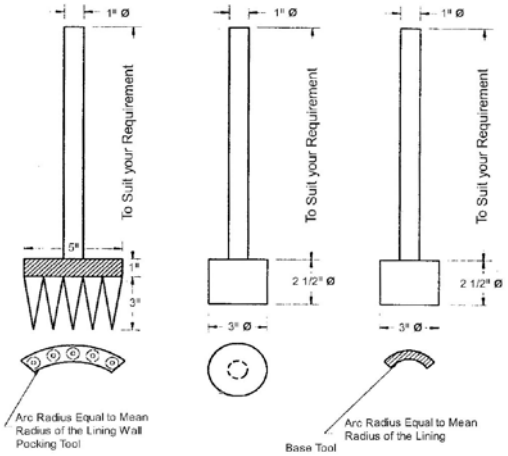


Fig. 1 Ramming Tools

Ram in layers and take care that each layer thickness does not exceed 40 to 50 mm. Use ramming forks tools only for ramming. When the bottom is rammed, the steel former is inserted and centered. Then ramming is continued up to the top. To prevent shifting of the former while ramming a starting block is preferably placed in.

The rammed material is then slowed heated to 1000^{o}C by means of induction in 6 to 10 hrs. Then the former is melted and charging commences. Initially use only clean, rust free and small size scrap. Fill up the crucible and heat liquid metal to sintering temperature. The holding period after sintering is about 2 hrs.

On starting up, take at least 4 to 8 melts continuously without intermediate cooling.

Adequate cooling of the coil by water is of great importance for prolonging lining life. The outlet water temperature must never exceed 20^{o}C above room temperature.

Once every week on holiday, the furnace should be emptied. The lining dimension shall be measured and inspected carefully. This will give an idea about the erosion that has taken place.

Sintering During First Heat after Relining of Induction Furnace.

This is very important operation and has to be done cautiously. Normally the supplier of the furnace recommends the sintering cycle and should be done as per his instructions.

While sintering, provide a thermocouple touching to the former and achieve desired rate of heating. Recommended rate of heating as per furnace size is as below.

a. 50^0C per hour for 15 ton and above furnace
b. 100^0C per hour from 5 to 15 ton
c. 150^0C per hour from 1 to 5 ton
d. 200^0C per hour below 1 ton

There should be continuous heating without any interruptions during sintering.

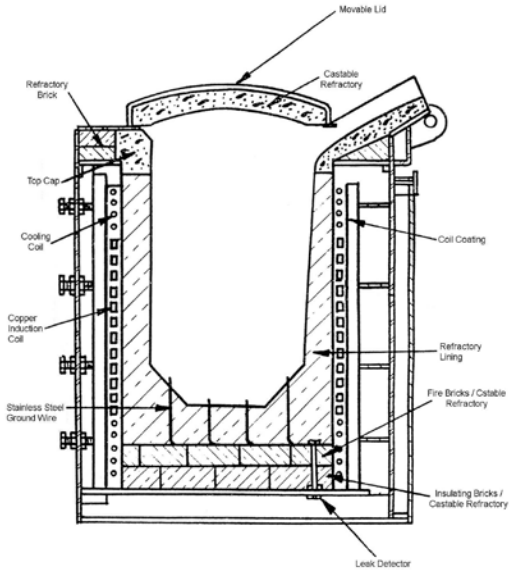


Fig.2 Typical Cross Section of Induction Furnace

Lining Problem - Solving Check List

A check-list of twenty questions is given for particularly baffling problems. If these steps are systematically followed the problem can, in most cases, be solved.

1. If this is a one off failure, then repeat everything with personal attention to details and in the situation, best possible melting practices.
2. If a repeat failure, is it in one shell only? Give it thorough maintenance and a clean working area. Remember that any activities close by could affect performance.

   If failure occurred in several shells, then ask yourself what is common to them all, e.g. cooling water system (when did you de-scale etc), type of charge and additives etc. Sometimes improvements can have a negative effect, e.g. higher carbon from improved coke may aggravate a super-heat-erosion problem.
3. May be the problem started with a new source or batch of ramming mass. Personally check material in stores to ensure that the first-in-first-out is followed.
4. Check stock card, location and condition of binder, additives, charge materials etc. If any item suggests that short cuts may have been taken then stock out.
5. Personally watch drying and mixing operation (preferable adding dye), positioning of former, placing of material in furnaces (esp. bottom corner) and ramming etc and calculate rammed density.

   Have there been any changes in tools used, personnel, supervision or procedures?
6. Is drying-out below 100^0C and warm-up to 800^0C sufficiently slow? Keep therm sticks handy (temperature indicating crayons etc.) How was it done in the past?
7. At melt-down, is bath level brought up quickly enough? Is final temperature held long enough and high enough? Cross check your thermocouple or pyrometer. Compare log readings with earlier successful runs.

8. In Case of Mains Frequency Furnace, operate at 66 to 80% heel for first 4 days or first several heats without shut down to sinter the lining fully. For single shift operation, keep furnace full of starting blocks on low tap to maintain temperature above 800^0C at all times till lining sinter zone is strong enough to withstand cooling.

   The best lining is made during the first week of its life. Was the failed lining shut down too soon may be for a holiday etc.
9. Start with several melts of good clean charge Use special feedstock if necessary. What was used previously to achieve successful campaigns?
10. Switch to normal charging and melting pattern. Refresh your memory again as to what was charged, how much and how. Observe stirring action. Any changes in source, cleanliness or storage policy for charge materials?
11. Look out for delays in metal analysis or adjustment, ladles coming late to furnace etc.

    Superheating is the single biggest enemy of lining life.
12. Think about melt additions or slag modifiers. What brand, quality or purity, how weighed and added, at what bath temperature or heel level, in what sequence, how long before tapping? Ask again - any recent changes? Beware of additions of which you do not know the composition.
13. Ask about previous (and observe present) slag generation and slag removal practices. Be observant. Does anything look or behave differently?
14. Ask about recent overhaul or replacement of furnace or control equipment, back up refractories or electricals, etc? (Changes in thermal conductivity or back up bricks, or cooling water temperatures can have far reaching effects on hot face temperatures and erosion resistance.)
15. Any changes in shift operation, weekend policy, power saving power cut or power failure management.
16. Consider the human angle, any changes in workmen or supervisors? Are there inter-personal relationships in incentives or overtime, in maintenance personnel or stores staff, in management style or expectations, in pricing or relationships with suppliers?
17. Think about the working climate in the melting shop. Do you value and reward consistent, systematic work habits or is it a case of them always ‘firefighting’ coping with crises, handling emergencies, under pressure to keep up with forever changing demands or disorganized work habits in the casting shop. It is hard to achieve a predictable lining life under these conditions.
18. Write down a list of all changes observed, however minor. Often, seeing a combination of three or four items on the list will give a clue to the problem. Writing down the observations also helps logical thinking and may remind you of aspects not checked.
19. Having decided what is the most likely reason for failure, correct that by changing, as far as possible, only one variable at a time. If you make too many changes, and results are erratic, cause and effect will elude you. But if you can learn from your experience or mistakes, progress and improvements are sure to follow.
20. Remember, you know your own operations best. You can help yourself (with honest questions and honest answers) far better than any outside “expert” can.

Medium Frequency Induction Furnaces

Mains frequency is 50 cycles per second (Hz) whereas medium frequency can be defined in the range of 100 Hz to 2000 Hz.

Main frequency furnaces have better stirring effect but need continuous running with some molten metal heel. Melting is relatively slow as power density is lower. The mains frequency furnace was commercially established during 1950-1960. However, due to the above disadvantages and with the commercialization of medium frequency furnaces during 1970-1980 off late the mains frequency furnaces are not popular and instead the use of medium frequency furnaces is increasing tremendously. At present there are more than 2000 medium frequency furnaces in use in India.

Medium frequency furnaces offer the following direct advantages over conventional mains frequency furnaces.

1. Require less power to achieve the same liquid metal output, i.e. lower kwh/ton of melting. There is saving in electric power to the tune of about 50 kwh/ton.
2. There is no necessity to keep molten metal (heel) in the furnace to run the furnace continuously. Thus no overnight holding power costs.
3. We can pump in more KW per ton of metal. Therefore one can use smaller capacity furnace, with lesser space requirement and shorter furnace relining time.
4. Variable power control gives accurate melting and holding temperature.
5. Shorter cold lining melt time and no necessity of starting blocks.
6. We can completely empty the furnace, hence there is no mixing of one grade of metal with other grade.

The stirring depends upon power input, capacity of the furnace and the frequency by the following formulae.

$$S \propto \frac{h}{d} \propto \frac{\text{Power input}}{\text{Furnace capacity} \times \sqrt{\text{frequency}}}$$

h – Height of molten metal above horizontal level.
d – Lined diameter of the furnace.
k – Constant which is 5 for cast iron.

For coreless induction furnaces $\frac{h}{d}$ = Cross stirring factor. Below 0.2 it is considered dangerous.

$\frac{h}{d}$ should be more than 0.4

From the above formula, it will be observed that the stirring increases as the power input is increased. It reduces as the capacity of the furnace is increased viz. after wearing of lining. It also reduces as the frequency is increased. I have observed that even if h/d is lower than 0.1 foundrymen are successfully using medium frequency furnaces for melting of Cast Iron and S. G. Iron.

Modern Techniques For Longer And Economical Induction Furnaces Lining

Preamble

One of the most important things in a foundry is to have a reliable friend and a well working and flexible melting induction furnace.

I call the furnace “she” as she blushes when you heat her up. She is the most important part in your foundry, she acts independently and often based on feelings, she is wonderful in full action and she rewards you plentifully if you treat her honestly and with respect.

Without molten metal of correct analysis at correct time with sufficient volume, no sophisticated foundry can survive in the long run.

The furnaces must run continuously with as few problems as possible at as low cost as ever possible.

Choice of Correct Material

For coreless induction furnace you can choose among the following lining materials depending on the alloy to be melted:

SiO_2 (Silica or Quartzite)
Al_2O_3 (Alumina)
MgO (Magnesite)

For normal grey iron or basic iron for ductile or malleable iron quartzite is the best. No other material can compare with the behavior of silica in that environment.

Also melting unalloyed steels as well as copper and brass will give very good results. However as always, the right supplier and the correct quality must be chosen with care, Silica (quartz or quartzite) can be found everywhere. Unfortunately I do find foundries all around using cheap local quartz and thereby jeopardizing the safety of the furnace and the workmen.

For alloyed steels the correct choice would be Al_2O_3 in the shape of corundum (brown, white), Al_2O_3/MgO material should be used.

If the furnaces are melting continuously and if the melting temperatures are very high (1700^0) MgO should be used.

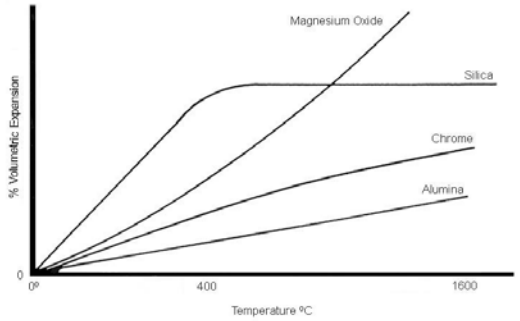


Fig. 3 Volumetric Expansion of Different Lining Materials

The expansion diagram gives a simple answer to why SiO_2 behaves so well in the coreless furnaces. After initial transformation at 573^0C of silica to quartz with a volume expansion of around 1.4% no further changes will occur except if the chosen quartzite is transformed to crystobalite. This could be a disaster and is one of the reasons why correct supplier must be chosen. A supplier taking full responsibility and having the technical knowledge and back up.

Deletion Of Asbestos Sheets

The preparation of the coil cement is of great importance not only to protect the coil but also to give a correct build-up of the total lining. The coil cement should not just be a normal cement but must be of a “soft quality” composed of a fine grained matrix. The coil grout shall at as a slipping plane and must not have any coarse grains that might damage the sensitive copper coils. The preparation and repair must be carefully carried through and no rough surface must be allowed as well as no thicker and thicker build-up can or should be approved. This must be dried before installing the lining.

Between the coil grout and the lining **no** insulating material should be used. In case pull or push put techniques for lining removal are used provide taper in the coil coating.

All use of asbestos should be avoided in coreless furnaces. Those foundries still using this material are actually paying money to achieve shorter lining lives.

Asbestos between the coil cement and the lining gives you the following disadvantages.

1. Dangerous for the health.
2. Time consuming installation.
3. Additional cost for material.
4. Shorter lining life as cooling effect will be reduced.
5. Less security as lining will be sintered all through.
6. More frequent coil problems sintered lining will lift coil upwards.
7. More difficult breaking out of lining as lining has no powder layer.

The influence of bricks and/or insulating fiber between quartzite dry lining material and coil cement in a coreless furnace.

To be able to judge the influence of bricks and ceramic insulating blanket between the coil cement and the dry quartzite lining material in a coreless furnace, the following calculation and assumptions have been made.

Lining Thickness – total 198 mm

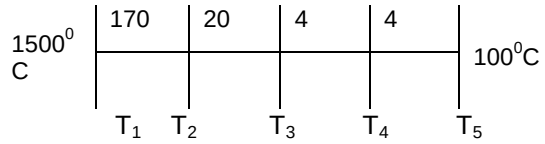
Metal temperature – 1500^0C

Temperature inside coil cement (towards center) 100^0C

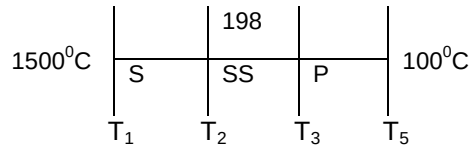
Value	Kcal/m.h. ^{0}C
For sintered quartzite	1.20
For semi-sintered quartzite	0.95
For powder quartzite	0.60
For fiber blanket	0.03
For asbestos	0.13

The following alternatives have been checked

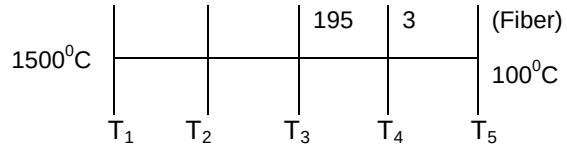
1.



2.



3.



S = Sintered (30%)
SS = Semi-Sintered (30%)
P = Powder (40%)

Alternative	T_1	T_2	T_3	T_4	T_5	QkW/M^2
1	1500	550	468	-	100	7.1
2	1500	1224	909	-	100	8.3
3	1500	1275	984	438	100	6.6

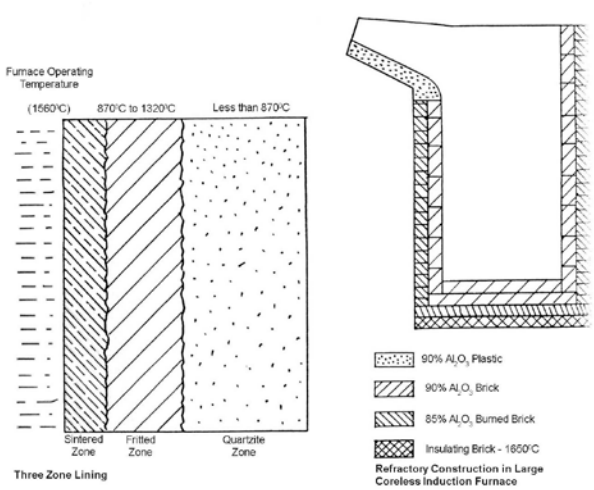


Fig. 4

Comments

By using one single fiber blanket (3mm) instead of bricks (20 mm) and asbestos (2 x 4mm), the energy loss through the wall will be reduced. However, the temperature will be high enough to create a semi-sintered material all the way out to the fiber, which certainly is a risk factor for cracks and break-through.

By using bricks and asbestos the quartzite material will be hard all through and the expansion movement within the silica can lift the bricks and will most certainly penetrate into joints between the bricks and thereby open up the possibilities of a material penetration.

By using quartzite only, at least 25% of the lining will be in powder form, which will itself act as a slipping plane and a self-healing area. The slightly increased heat loses are negligible compared to the heat losses from an uncovered furnace. The Q value for the molten iron surface is 800Kw/m^2 (100x).

Recommendation

Based upon above calculations and experience all over the world, I strongly advise everybody using dry quartzite materials in coreless induction furnaces with a well prepared coil cement, to delete all kinds of insulating material between the quartzite lining and the coil cement.

In case of no coil cement I would recommend a layer of mica sheet (0.5 mm) between the coil and quartzite.

The advantages are as follows:

7. Less time to install.
8. Less cost of insulating material.
9. Higher safety margin due to self-healing powder layers.
10. Less radial pressure on coil.
11. Less risk for break though caused by complete sintering.
12. Longer lining time.

USE OF REUSABLE FORMER TECHNIQUE

Features

Considerable savings on former costs, as ramming former is not melted down for sintering, but can be removed and reused several times.

Removable Former

A lot of saving can be done by using a removable former. One and the same former can be used several times. In some cases even more than 200 times. Depending on the size of the former each former will cost Rs. 10,000/- to Rs. 30,000/- It is up to everyone to make his own calculation how much will be gained.

Former design

The former must be in one piece. Slightly tapered, specific shape and detailed dimensions are shown in **Fig. 5**

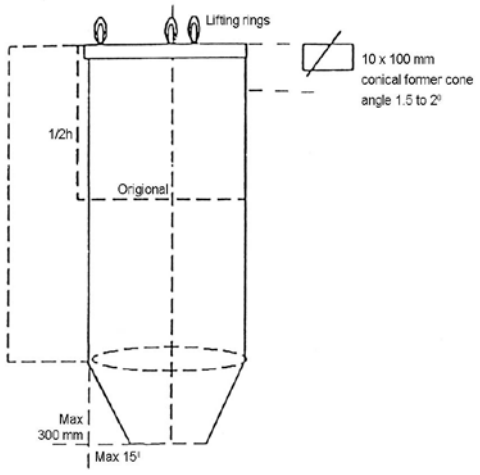


Fig.5 Removable Former

Former diameter (mm)	Thickness of plate in former (mm)
Ø < 800	6
Ø = 800 - 1000	8
Ø > 1000	10

Lining Material

Most dry monolithic materials can be used, if the refractory material being used, has been found to have an even and reliable quality standard. No special sintering agent or other additions are required.

Lining Procedure

The refractory material can be densified with established techniques e.g. by former vibrators, hand ramming or internal vibrators. Prior to inserting the former, coat the outside with a mixture of oil and graphite powder. Keep oil/graphite film thin. Alternatively cover the surface by 5 mm corrugated cardboard.

Sintering Procedure for Use of Removable Former.

Before former can be removed the lining must be heated up to approximately 450^0C. Preferably 450 ± 10^0C.

- Increase temperature by using gas torch and/or coil power. Temperature rise is about 100^0C per hour. Hold at 450^0C about 1 hour.
- Control the temperature by using thermocouples and make sure of even temperature distribution form bottom to top of crucible.
- Cool down former to approximately 200^0C with compressed air. The cooling rate should be as fast, with as much air, as possible. Time required for cooling is 15-30 minutes depending on furnace size.
- Raise temperature to about 400^0C within 1 hour, then from 400^0C to approximately 1100^0C as is normally done.
- Fill the furnace with liquid iron of about 1300^0C. If liquid metal is not available melting should be continued. Raise temperature to sintering temperature and hold for 1 hour.
- Alternatively set starting blocks after removal of former and raise temperature to about 400^0C within 1 hour, then with about 100^0C per hour until block starts to melt. Melt block completely and raise temperature to 1430^0C before charging. Charge and fill up furnace keeping furnace full and raise temperature to sintering temperature and hold for 1 hour.

Storing of Former

Clean the former surface and keep the unit in a dry place. Avoid warping by means of supporting or reinforcement device.

Recommended Further Reading

1. BCIRA Boradsheet 204-2
2. Longer life and cost effectiveness of Induction Furnace lining for improved profitability by MR. JAN W Kjehberg m 44 th IFC's Volume February 1996.

Installation By Using Former Vibrators

The most frequent way of installing induction furnace is to use manpower. This is unfortunately neither the best nor the cheapest nor the fastest. The installation by hand ramming can cause a lot of problems as there is always a risk of bad compaction, torn coil cement of fiber, litter falling down etc.

By reducing the time of installation and by using suitable equipment these problems can be avoided.

INDCROSS makes the installation with one man in one hour which normally takes 8 hours by two or three men. The compaction will be 10-15% better and this will give a longer lining life. You will, from installation to installation, get the same compaction and you will not be dependent on human mistakes.

The equipment needs almost no maintenance, just normal care.

INDCROSS is produced in India but the vibrator is imported from Europe.

This equipment can be used for furnaces with diameters between from, 300 to 1500 mm.

Furnaces with melting capacity up to 25 tons are successfully using this equipment.

Larger furnaces, rare in India, must chose a so called Junker – Bosch type with 3 to 4 legs. This is an equipment with electrical vibrators. Compared to a pneumatic system in the INDCROSS. The Junker Bosch type does not give good compaction due to lower frequency, which gives a knocking effect rather than vibration.

Use Of Electric Vibrator

If at present 41 man-days are required for relining of furnace. With electric vibrator, about 16 man-days will be sufficient. Thus, savings of 25 man-days i.e. 25 x 235 = 5975 Rs. per lining or for 12 linings in a year, annual savings = Rs. 71,700

Reusable former savings = 12 x 9500 = 11, 400/-

Fixing INDCROSS Vibrator Inside Former

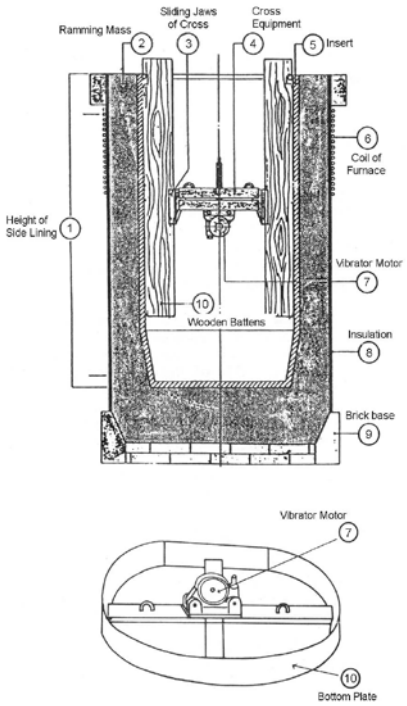


Fig.6 Vibratory Compaction of Dry Refractory Mass for Induction Furnace – The Vibrator Cross.

2) Important Key Control areas during operation of Induction Furnaces

Introduction:

A furnace is like a human stomach, especially for a metallurgical industry. It is ever so hungry for energy (i.e. food). And its right function commands that its various operational parameters are holistically optimized such that not only the impacting factors are understandable, but also actively controlled From that perspective it is imperative that a great furnace operation encompasses a complete recourse to one and all of the following factors viz i) process technology ii) instrumentation and control, iii) end-users behavior and attitude iv) economies of scale, v) changes and vi) governmental policies.

For right operation for energy and environmental quality (pollution) efficiency (OQEEE) many suggestions are in vogue, which are based on a broad framework of experimental and theoretical knowledge and are tailor made for specific instances, depending upon the practices or circumstances prevalent at the systems level. These suggestions mainly revolve on housekeeping and retrofitting, providing generally end of pipe solutions unless design modifications are considered relevant. It has been the general experience that a minimum 25% decrease in the cost of fuel or energy can be achieved, the moment these simple suggestions are applied to with faith and maintenance of the spirit

of energy conservation. Similar are the results of each endeavor for environmental quality up-gradation, whether they involve monitoring of exhaust quality, or installation of secondary or tertiary equipment/instruments or input control. Consequent improvement in product quality and environmental quality are corroborations of the energy efficiency improvement exercise and accrue to the industry as a bonus. This bonus has a pious implication (i.e. deliberate fall out), facilitating all round cost reduction.

Rightly so, in a Foundry operation, where the energy in melting exceeds 60% of the overall energy expenditure and percentile increase would impair the QEEE Dynamics (Quality, Energy and Environment Efficiency) of the plant.

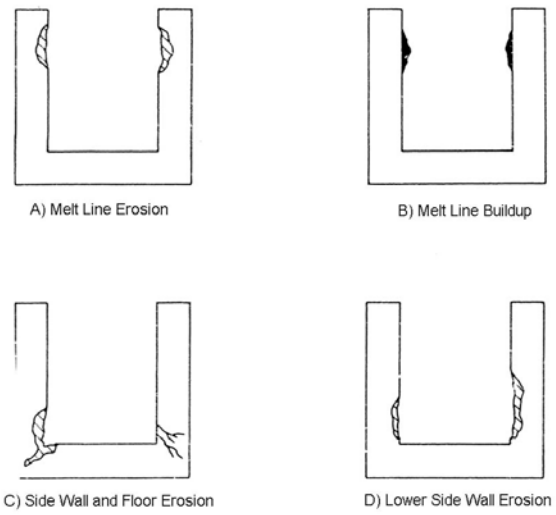


Fig. 7 Some Typical Wear Pattern of Lining

Concluding Remarks

The Metallurgical quality of a casting is a function of judicious melting and casting procedure, namely the heat delivery and withdrawal. The design of heating equipment is important from the Energy point of view.

Right installation of lining, sintering and correct way of melting will give you better life of lining.

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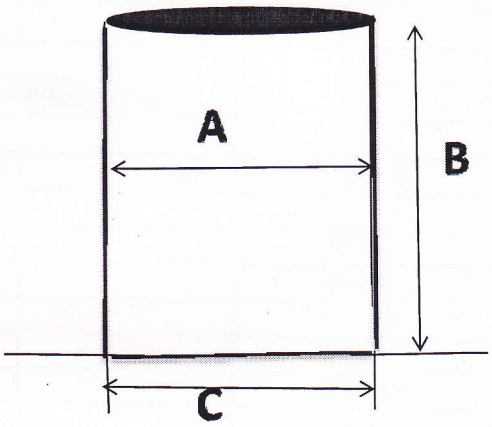
Format for Furnace Sintering

FURNACE MAKE:-	

DATE :-	FURNACE NO.	

TOOL USED FOR LINING : PNUEMATIC VIBRATOR

FORMER SIZE :



	REQ.SIZE	ACTUAL SIZE
A =		
B =		
C =		

	USED QTY	RATE	COST
RAMMING MASS USED :			
FORMER			
BORIC ACID % :			
S S WIRE :			
ASBESTOS SHEET			
W. CEMENT :			
TOTAL			

PREMIXED

LINING START TIME

PROCESS	MANUAL PROCESS	WITH VIBRATOR
	ON TIME	OFF TIME
FOR BOTTOM LINING — 10 to 15 Min.		
FOR SIDE LINING — 30 TO 40 Min.		

RAW MATERIAL USED FOR SENTRING

PIG IRON	MS SCRAP	RR	CPC	Silicon	Mn	Cr	Cu	Sulpher

SENTRING CYCLE : WITH THERMOCOUPLE

SR NO	TIME	Min's.	TEMP.
1		20 min	deg C
2		40 min	deg C
3		60 min	deg C
4		80 min	deg C
5		100 min	deg C
6		120 min	deg C
7		140 min	deg C
8		160 min	deg C
9		180 min	deg C
10		200 min	deg C
11		220 min	deg C
12		240 min	deg C
13		260 min	deg C
14		280 min	deg C
15		300 min	deg C
16		320 min	deg C
17		340 min	deg C
18		360 min	deg C

Once the temp of sentring former reaches at 900 deg.C
Keep going on regular melting with full power ,when the temp reaches at 1500 deg.C hold the metal for one hour by keeping power at 50 KW& tap the metal.

POURING DETAIL'S

PART NO	NO OF BOX POURED	B.WEIGHT	TOTAL WEIGHT

TAP.TEMP

POURING TEMP.

UNIT CONSUMPTION

I St Reading before sentring cycle	
II nd reading after sentring cycle	
Total unit consumed	
Total unit / Ton cost	

WORKER PRESENT

FOR LINING

		RATE	COST
STAFF			
WORKER			

FOR SENTRING

STAFF			
WORKER			
		TOTAL	

TOTAL COST FOR LINING	
TOTAL UNIT COST	
TOTAL LABOUR COST	
TOTAL COST	

SUPERVISOR SIGN.

EFFICIENT INDUCTION MELTING PRACTICE

DO'S & DON'TS

Few important points to be noted by foundrymen while operating Induction Furnace are as follows.

DON'T & DO'S

1) Do not operate furnace at lower Power than rated power.

Always draw full power during melting and try to finish melting as early as possible. Pumping lower power means increasing melting time, there by increasing losses & power consumption.

DON'T & DO'S

2) Never allow any limit to appear. This will reduce power.

Select proper scrap combination to avoid any limit appearing on Panel. Too heavy scrap will show excess charge limit where as too light scrap will show Voltage Limit.

DON'T & DO'S

3) Do not leave furnace open during melting.

Make use of Lid or any cover of ceramic blanket to avoid /minimise Radiation Losses.

DON'T & DO'S

4) Do not increase bottom lining or side wall thickness of Lining for any reason.

Increasing lining thickness has more disadvantages & very less advantages. Increasing thickness means reducing Volume of the melt, Increasig the possiblity of running furnace at Voltage Limit, This will increase melting time & power consumption.

DON'T & DO'S

5) Do not allow any one to work under furnace .

If at all any one wants to do some maintenance work, lift the furnance, give some mechanical support or hold by EOT Crane then only allow to work.

DON'T & DO'S

6) Ensure 3 mm holes on former,

Every 150/200 mm spacing, holes are to be provided on meltout former. Hole dia should not be more than 3 mm.

DON'T & DO'S

7) Do not allow empty furnace to cool very slow.

It is benifitail to do rapid cooling of empty furnace. This gives more No of cracks with lower depth; where as slow cooling generates less no of cracks having more depth. It preferrabble to have lower depth of cracks.

DON'T & DO'S

8) Do not make cold start heat too slow.

If you have ensured forced air cooling on empty furnace, Cold start time can be reduced. It should take 20% longer time than standard melt cycle.

DON'T & DO'S

9) Never remove worn out lining without witnessing.

Always measure the left over thickness of bottom & side lining. Uniform errosion up to 50% is safe and

permissible. Observe for the powder portion near coil.

DON'T & DO’S

10) Not necessay to use asbestos or mica.

Asbestos restricts the water cooling of ramming mass. Powder portion thickness near the coil is reduced.This reduces the safety of coil.

DON'T & DO’S

11) Do not make Coil cementing thickness more.

Coil Coating thickness 3 to 5 mm for smaller furnaces , 5 to 8 mm for bigger furnaces.

DON'T & DO’S

12) Never use blunt ramming tools for lining.

Ensure spikes are sharp pointed, with taper of 50 mm on 18 mm round bar.

DON'T & DO’S

13) While performing lining, do not exceed each layer more than 50 to 60 mm.

Compaction will be better with sharp tools & layer not more than 50 mm. Do not use flat rammers during side lining. This will give real monolithic lining.

DON'T & DO'S

14) Never pay electricity Bill witout studying carefully.

Find out about Demand charges, Power Factor, Penalties & Incentive. Anaylise & Take corrective action & pay the bill.