Iron Making
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Lecture - 31
Iron Making Lecture 31

Here there are two figures of blast furnace, which I would like you to pay attention on it on.

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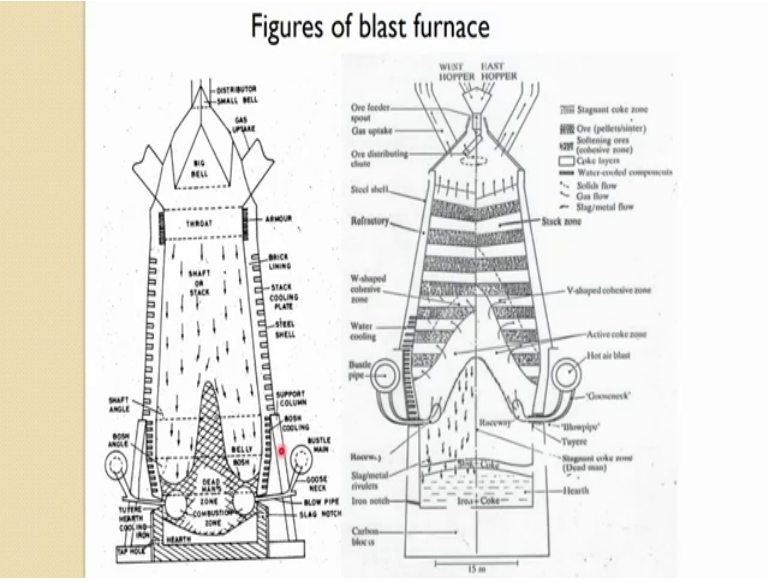

Then because what we will be discussing now you may need some idea of the various zones of the blast furnace. So, especially like this is the bosh region and sorry this is a barely region, which is sort of a cylindrical and this is a bosh region. So, like here you can see this is a belly region and this is a bosh region and this is the state region dead man zone and this is the hearth combustion bustle pipe.

So, that is a bustle man and Boston angle tuyeres blow pipe goose neck, mental, tape hole, well throat, stock shaft or stick these are the thing which we would be discussing in this one especially about the bustle pipe blow pipe mantle bosh belly stack and this cooling arm plates where water cooling is taking place.

So, you should be aware of deposition of these zones and other thing and this is a bell less charging and be the bell. So, you should be aware about the difference in this,

though we have talked already about this in the construction and interior of the blast furnace and all those things.

So, just to refresh your memory I am again showing this figure to you. So, you can understand when we go further about the blast furnace few operations.

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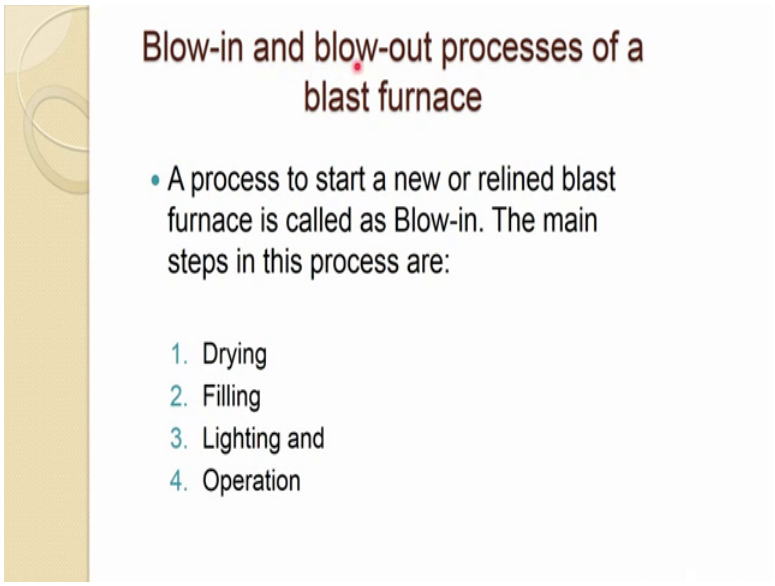

So, there are two important operations in the blast furnace, one is blowing and another is blow out processes of a blast furnace. So, if process to start a new or relined blast furnace is called as blow in. So, whether it can be a new furnace or it could be even a relined one. So, the main steps in this process are.

So, how to start the new furnace the steps are drying filling lighting and finally, the operation. So, we will discuss these four steps one by one. So, you can understand what is the meaning of all these and how long it takes and time.

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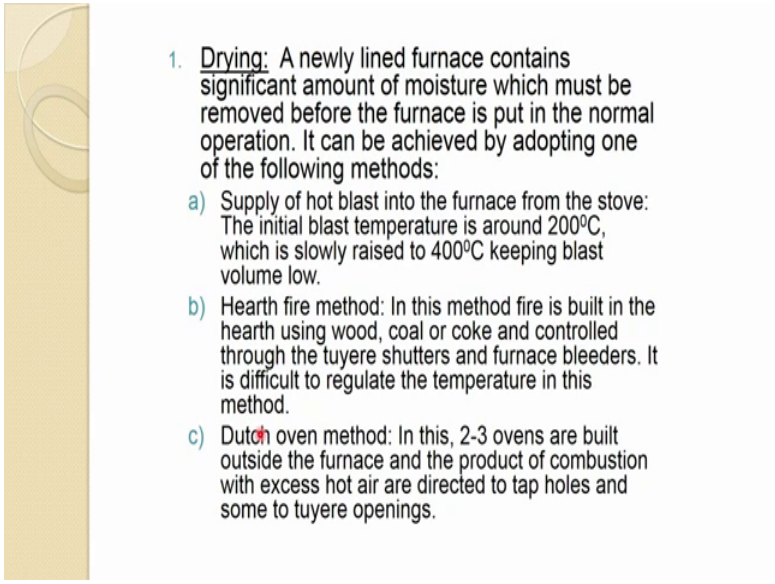

So, the first step is drying. So, a newly lined furnace contains significant amount of moisture which must be removed before the furnace is put in the normal operation. So, this is a very critical step and very important and one has to make sure all moisture must be driven away.

And the time is spent in this its worth it, then later on regretting when some problem comes as you encountered during the operation of the blast furnace. So, it is a what is spending time on removing of the moisture completely from the brick and other places; then this can be achieved by adopting one of the following method, so either to supply hot blast into the furnace from the stove. So, if they are existing large furnaces in the plant you can always use the stock of that one to supply the hot blast.

So, in initial blast temperature is around 200 degree Celsius and which is slowly raised to 400 degree Celsius keeping the blast volume low. So, that can be done from the tap holes and through the tears you blow that hot blast which is you get it from the stove.

If the stoves are not there and there is only standalone blast furnace in the plant, then one can use the second method hearth fire method, but this known is. So, in this method fire is built in the hearth using wood coal or coke in control through the tuyere shutters and furnace bleeders. It is difficult to regulate the temperature in this method. So, so in this one at the bottom of the hearth which you use this carbonaceous material to burn it by using the control air through the tuyeres shutters and furnace bleeders, but only problem

is in this one its a bit difficult to control the temperature in the furnace. But if first stoves are not there this is one of the method one can adopt to remove the moisture and heat up the furnace in the starting.

If that is not there then there is another method which sometime as you know Dutch oven though its bit expensive. So, in this one you what is called a Dutch oven method. So, in this one usually 2 or 3 ovens or 4 ovens are built outside the furnace. So, this is actually in one way the extra ovens you are building outside the furnace or more sort of infrastructure and one is needed in this one. So, its a bit expensive in that way out. So, ovens are built outside the furnace and the product of combustion, with excess hot air are directed to tap holes and some to the tuyere opening.

So, essentially what you are getting? You are getting a hot a product of combustion from this and with the excess hot air, which is directed from tuyeres or tap holes opening you get the temperature the way you do get it in the first method. So, by adopting this one of these method one can remove the moisture from a new blast furnace or re lined furnace, which is an essentially tapped to birth the operation.

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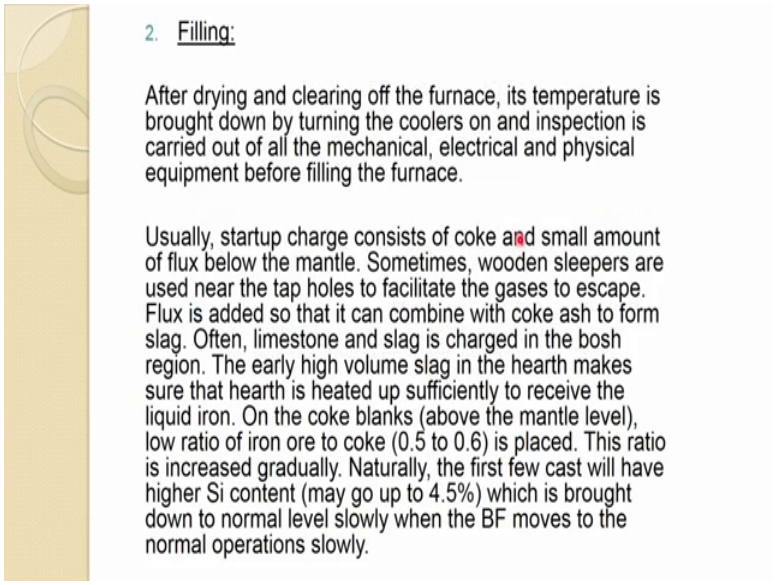

The second step consists of filling. So, after drying and clearing off the furnace clearing off the furnace if you have used the second method or some others. So, you have to remove whatever is left over there. And clearing off the furnace its temperature is

brought down by turning on the coolers and inspection is carried out of all the material mechanical, electrical and physical equipment before filling the furnace.

So, this is a very important and essential part in all the blast furnace starting up. Because now this is the last chance which gives you to rectify if there is any problem in any of the equipment coolers are on. So, temperature goes down in that one even the personnel can go inside and check the things and check all the thing outside cooler mechanical electrical physical all things that are running and one can check, if there is any problem. Because when the furnace is operation all these things are quite expensive and very difficult to maintain.

So, this to do list is prepared during this time and all checking takes place take place in during this time before filling. So, usually start up charge consist of coke and a small amount of flux below the mantle. So, below the mantle you put coke and a small amount of flux. Sometimes wooden sleepers are used near the tap holes to facilitate the gases to escape.

So, when the do the temperatures start rising. So, due to this coke flux and things are there, then sometime it difficult really to escape the gas gases of course, they go from the top the temp top is also open in the starting, but you can put the wooden sleeper near the tap holes. So, that gives a good sort of forces to escape the initial gases; flux is added as mentioned here so, that it can combine with the coke ash to form.

Slag often limestone and slag is charged in the bosh region. So, the early high volume slag in the hearth makes sure that hearth is heated up sufficiently to receive the liquid iron. So, naturally which you are putting a small amount of flux. So, starting slag is more stupid siliceous site, silicon site as and that is actually good and early we need also high volume slag. So, you put more slag and that make the hearth heated up. So, it is able to collect the liquid iron when furnace is in the normal operation.

So, on the coke blank they work the mantal level low ratio of iron ore to coke generally 0.5 to 0.6 is placed and this ratio is increased gradually. The first few cast will have a higher silicon content which may go up to 4.5 percent which is brought down to normal levels slowly, when the blast furnace moved towards the normal operation. When they say towards the normal operation slowly, I do we start this iron ore to coke ratio to the

normal one and then the normal operation is established your even silicon content also additives during that time.

So, this is the filling process after drying, it is done in the blast furnace and after that once you have pegged it with over and other things, then lighting.

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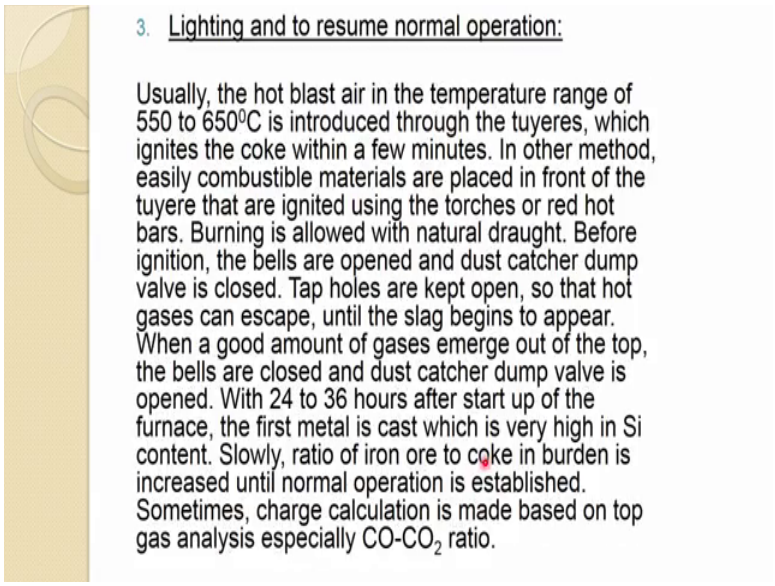

So, lighting and operation it has when combined into one during the starting we put it third and fourth, but here is it is combined when it is in meters you can see the difference. So, usually the hot blast air in the temperature range of 550 to 650 degree Celsius is introduced through the tuyere which ignite the coke within a few minutes.

So, when you are injecting that sort of high temperature blast air, which will coke will ignite very soon. So, in other method, this is one of the matter in the another method what we do? We put easily compressible materials are placed in front of the tuyere and that are ignited using the gas torches or red hot bar by inserting the radar bars these are sort of an old one mutually is using the gas torches is tuyering.

Burning is allowed with natural draught. So, before the ignition the bells that is stove bells are opened and dust catcher dump valve is closed. When they start in lots of gas amount dust and other thing would be there. So, tape holes are kept open so, that hot gases can escape until the slag begins to appear. So, these things are done till the slag begins to appear in the hearth region.

So, when a good amount of gases emerged out of the top the bell are closed and dust catcher dump valve is opened. So, now, all the gases dust catcher goes through that with 24 within 24 to 36 hours after a startup of the furnace the first metal is cast which is very high in silicon content slowly ratio of iron ore to coke in burden is increased until normal operation is established.

Sometime charge calculation is made based on top gas analysis especially CO-CO 2 ratio.

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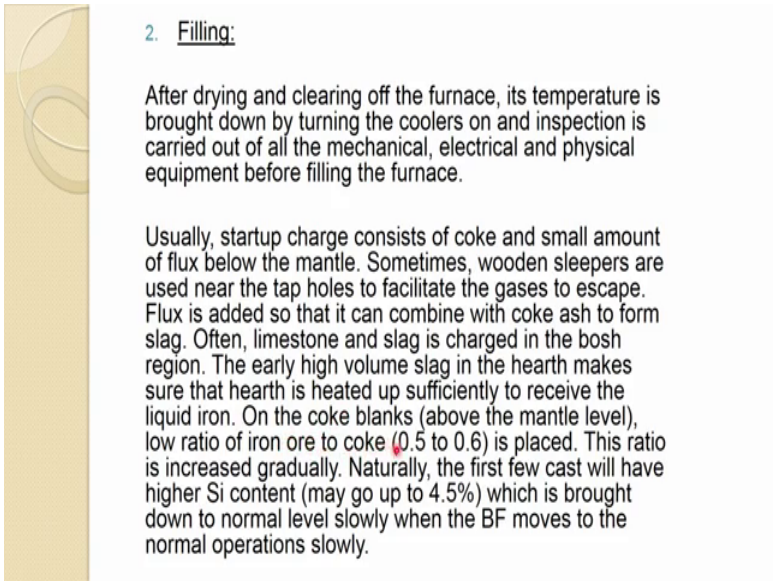

So, as we mentioned in the previous in this slide that any ratio of iron ore to coke is 0.5 to 0.6 and slowly it increases 0.05 or 03 sort of ratio slowly and another way of doing it to analyze the CO-CO 2 ratio and based on that as you can slowly increase the iron ore content into the charge.

So, that another way of doing it until the normal operation assumes. So, this is sort of a starting a normal a starting process of the blast furnace, which is a new one and relined once many times you shut down the blast furnace when the when its life is over and you have to re line it and again you have to start in the same way.

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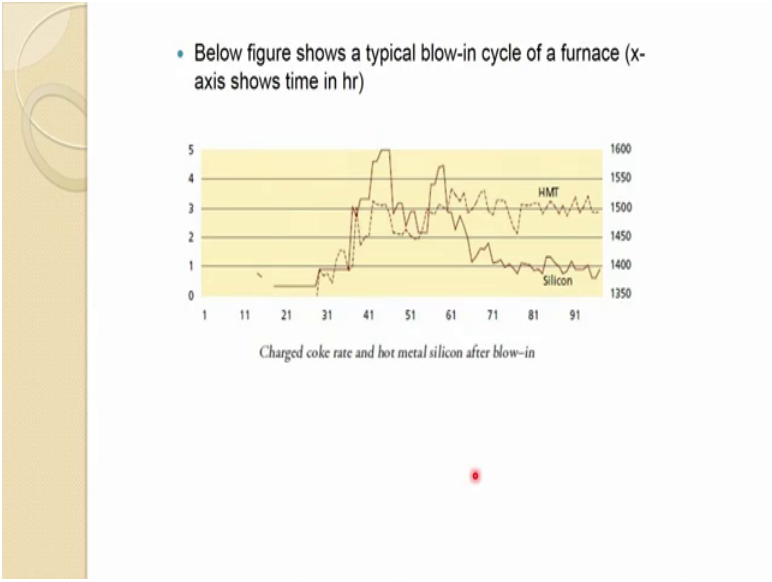

So, some of this figure shows a typical blow in cycle of a furnace. So, x axis this is showing hours this. So, the silicon content in percentage and that is the hot metal temperature.

So, as you can see that is when it is start so, it not taking care of the time of drawing and other. So, when the blow filling and after lighting start the third step and slowly the temperature rises and it. So, here as you do it and first metal sort of probably is appearing somewhere here, and you can see the slag had already build up and slag content slowly increasing or the actually silicon content in the slag and which as you can see silicon content in the slag is reaching almost 5 percent and it is slowly reducing edge you start.

So, there you can say probably the first casting of the slag, which is appearing here and because you are starting the now over to coke ratio; so you will increase form slowly this ratio is coming down. And it finally, it reaches to its normal silicon content less than 1 percent. So, that is where the normal operation is resumed and even your hot metal temperature is getting stabilized here.

So, this shows almost three to four days minimum is taking to get the normal operation of the blast furnace, after blow in.

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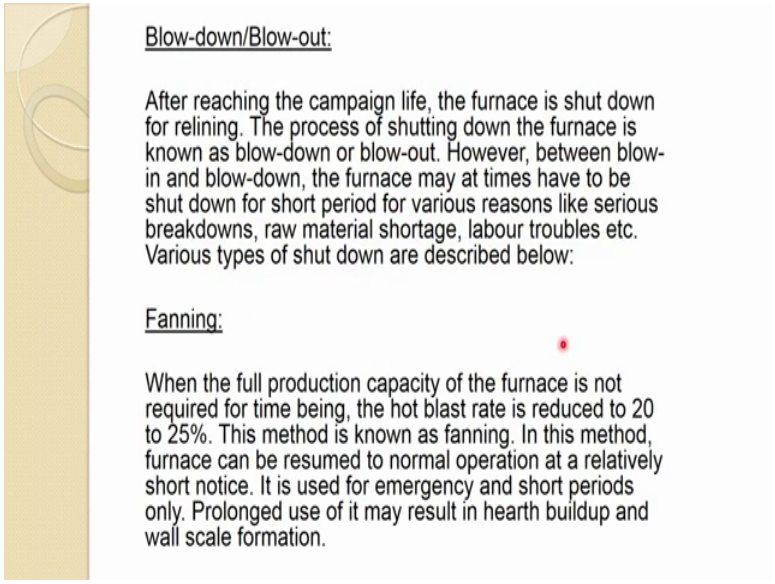

So, like blow in we also have the operation like blow down or blow out. So, blow down and blow out is after reaching the campaign life, the furnace is shut down for relining.

The process of shutting down the furnace is known as blow down or blowout. However, between blow in and blow down the furnace may at times have to be shut down for short period for various reason like series breakdowns, raw materials shortage, labour trouble etcetera. So, one is furnaces which reach the campaign life. So, it has to be completely shut down until it for relining or by other region if one had to shut it down completely.

Another one which is very often it is done now in the plant due to very serious breakdown in the equipment or in some other thing. Sometime you are running sort of the raw material sort is labor problem or any other thing comes. So, you have to set it down and not in as sort of a shut it down is in one way you have to hang the blast furnace for few hours to few days depending what sort of problem it is.

So, you cannot really set it down the blast furnace, due to these problem because as you know its quite difficult at setting down the process, we will discuss about that and not just shutting down especially the restarting of the blast furnace at a blowing its a long process and quite expensive.

So, one cannot just set it down like that. So, there are ways when a sort period disruption from hours to days happened there are there are ways by which this sort of problem can

be handled. So, there are some methods. So, various types of shut down are described below one is fanning. So, when the full products and capacity of the furnace is not required for time being, the hot blast rate is days to 20 to 25 percent.

Many time its happened there is a less demand and supply is more. So, you have to reduce the production and one of the reason that time as you can do by reducing the hot blast rate to this or some umm thing at the downstream has a broken down and then one had to take care of it. So, one has to again reduce the capacity of products and rate of the blast furnace.

So, that is the time do you take the hot blast rate as a by 20 to 25 percent out. So, this method is known as fanning. So, in this method furnace can be resumed to normal operation at a relatively short notice, it is used for emergency and short period only prolonged use of it may result in hearth buildup and wall scale formation.

So, this is for a very short period, it is used and for emergency and other thing. So, this is one of the ways you can reduce the flow down the furnace for few hours.

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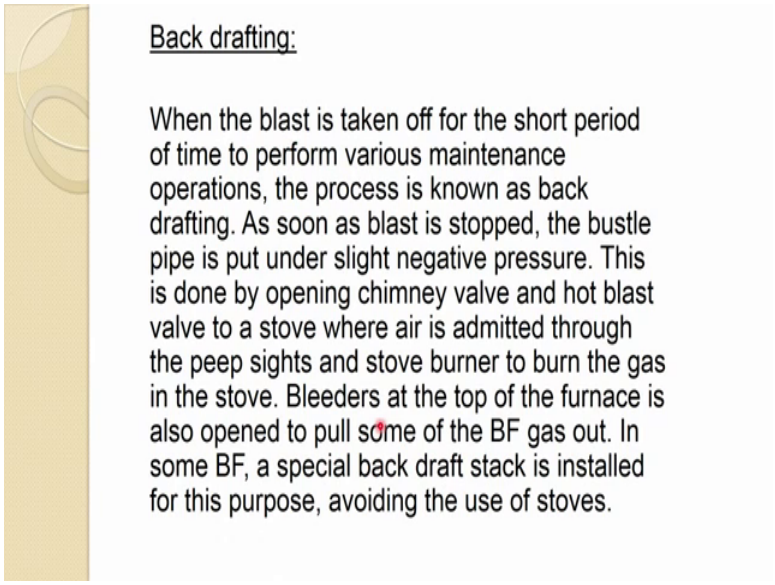

Another one is back drafting its back drafting when the blast is taken off for the short period of time. So, here taking knob the whole blast nothing is coming.

And the previous one is you can see 20 to 25 percent is reduced. So, here when the blast is taken off for the short period of time to perform various maintenance operations the

process is known as back drafting. So, as soon as blast is stopped the bustle pipe is put under slight negative pressure, this is done by opening chimney valve and hot blast valve to a stove, where air is admitted through the peep sights and stove burners to burn the gas in the stove bleeders at the top of the furnace is also opened to pull some of the blast furnace gas out. In some blast furnace a special back draft is stack is installed for this purpose avoiding the use of stoves. So, many terms which are used here mean do you have seen in those figures. So, I do not have to repeat otherwise you can go again look at the figures and see those things.

So,. So, in this one actually a negative pressure is put on the bustle pipe, and this stops the gas is burn in the stove. Bleeders at the top of the furnace is also opened and to pull some of the blast furnace is gas out and in some blast furnace a special back draft a stack is installed for this purpose.

So, if this is there, then you do not send it to stops and you avoid the use of stoves in that. So, that is called back drafting and another process of blow down it is a banking.

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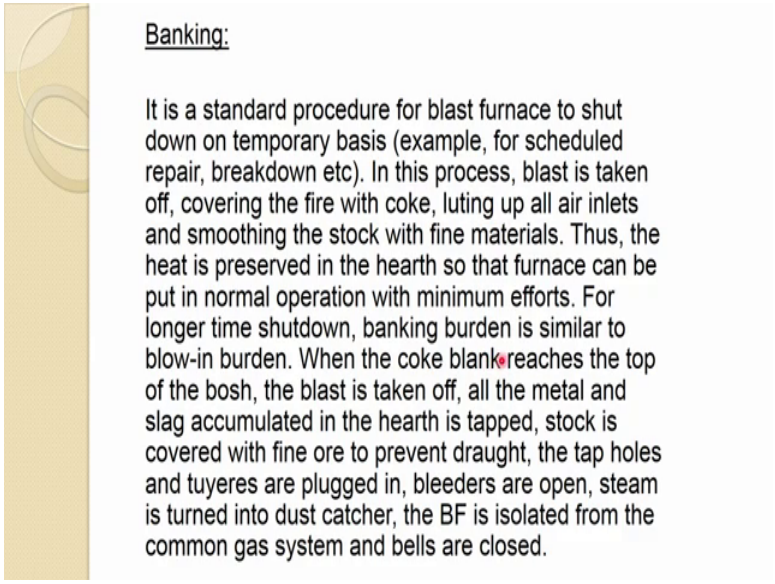

So, it is a standard procedure for blast furnace to set it down on temporary basis. So, example for again scheduled repair break down etcetera. So, this is a actually a longer period of time in a comparison to josh this back drafting.

So, in this process blast is taken off covering the fire with coke. So, it totally taken off covering the fire top with coke, luting up all air inlets and smoothing the stock with fine materials; thus the heat is preserved in the hearths. So, that furnace can be put in normal operation with minimum efforts; so to fire covering your fire or actually the stock with the coke just closing up all air inlets and smoothing the stock with fine material. So, you are preserving the heat for longer times shutdown banking burden is similar to the blow in burden. If you would like to set it down for a much longer periods then the burden would be the same as we had in the blow in period.

So, when the coke blank reaches the top of the bosh the blast is taken off all the metals and slag accumulated in the hearth is tapped stock is covered with fine ores to prevent draught the tap holes and tuyeres are plugged in bleeders are open steam is turned into dust catcher the blast furnace is isolated from the common gas system and bells are closed.

So, these are the thing which is done and this one. In fact, it is necessary that every day one should inspect it the level of the stock how the charge is sinking.

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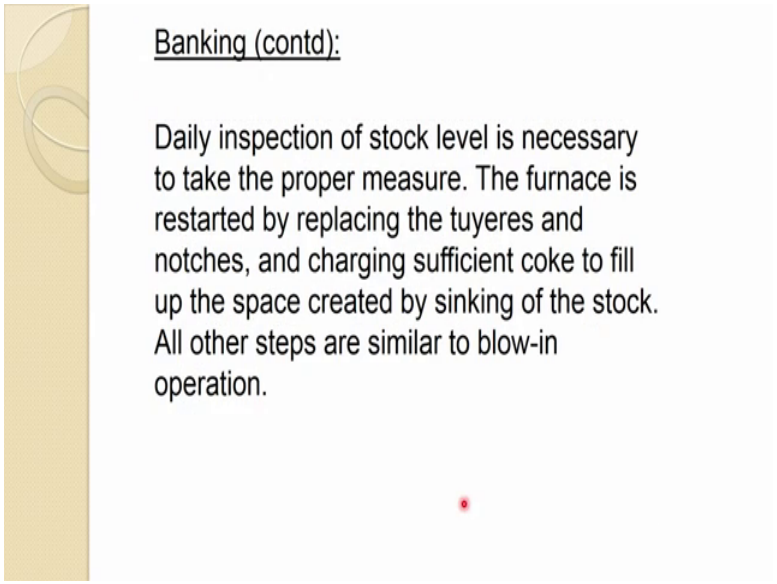

So, daily inspection of stock level is necessary to take the proper measure. The furnace is restarted by replacing the tuyere and notches and charging sufficient coke to fill up the space created by sinking of this stock.

So, all other steps are similar to blow in operation. So, this is actually for a longer period of time if you would like to set it down the furnace, then banking is done and in this one every day one has to inspect the stock and take the necessary action it should not be descending very fast then necessary action should be taken so sufficient. So, most of the other steps in this one are like a blow in operation which we had discussed before.