Iron Making
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Lecture - 32
Iron Making Lecture 32

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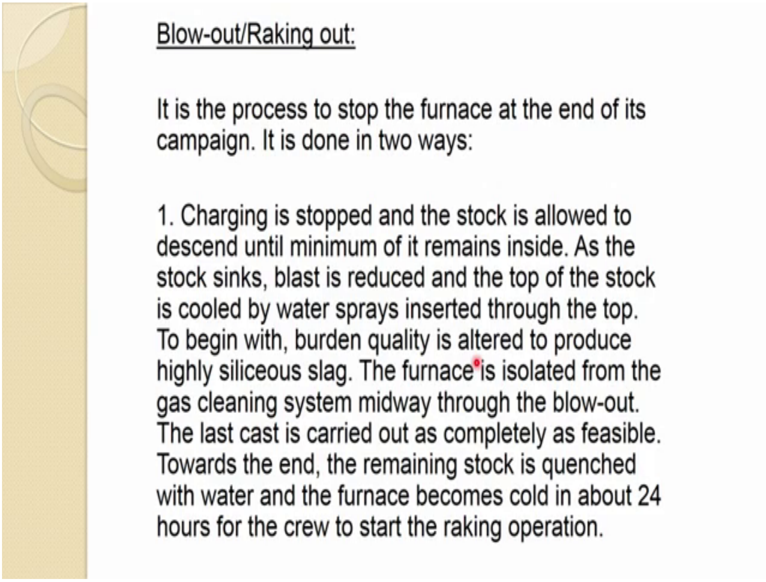

After that we have another one is like a blowout or raking out. So, it is the process to stop the furnace at the end of it is campaign. So, now they we had now 3 of the things one is fanning, where just for a for emergencies you want to set it down for few hours like that it is not used for the long purpose and then we have a bank drafting which is used a little longer than the fanning purpose for maintenance and others and then we had the banking one where large time is required. So, you goes for it goes it goes for days.

So, when you need this thing for date to set it down the blast furnace the time banking is required and then finally you have to set it down let us say for in relining or the furnace life is over, then we go for this blowout and raking out operation. So, in this process at the end, so it is done in two ways 1 is charging is stopped and the stock is allowed to descend until minimum of it remains inside, as the stock sinks blast is reduced and the top of the stock is cooled by water spray inserted through the top. So, remember in this 1 water spray in started from the stock to cool the charge at the stock line.

So, to begin with burden quality is altered to produce highly siliceous slag. So, which means you put this silicon globular course and then the furnace is isolated from the gas cleaning system midway through the blowout, the last cast is carried out as completely as possible towards the end. The remaining stock is quenched with water and the furnace becomes cold in about 24 hours for the crew to start the raking operation.

So, this raking out is coming from this raking operation then the personal starts the this operation. So, here you use the water spray to cook cool it down and of course, after the and naturally again use a use highly siliceous slag towards the end of it as we do in the blow in and the starting here toward the end is you do the siliceous slag, which can easily pass through that and the furnace is isolated in the mid way to that.

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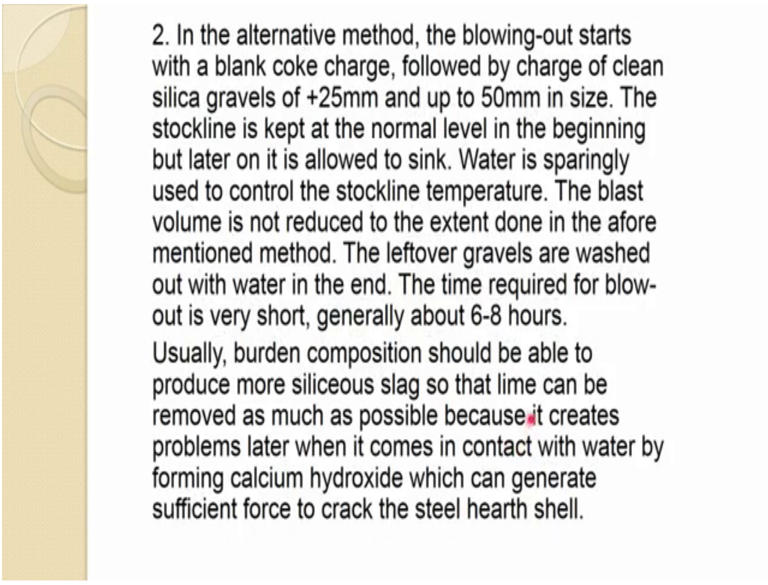

In the second one that is an alternative method the blowing out start with a blank coke charge, followed by a charge of clean silica gravel of 25 millimeter and up to 50 millimeter in size. So, it is start with this material from the starting, the stock line is kept at the normal level in the beginning, but later on it is allowed to sink; water is spreading spray sparingly used to control the stock line temperature.

The blast volume is not reduced to the extent done in the previous method. So in the previous mini method we reduce the blast volume quite a lot, but in this 1 you do not do that much, the leftover gravels are washed out with water in the end the time required to blow out is very sore generally about 6 to 8 hours in this case. So, this is a very quick method and usually burden compositions should be able to produce more salacious like because anyway you were putting silica gravels.

So, that lime can be removed as much as possible because it creates problem later, when it comes in contact with water by forming calcium hydroxide which can generate sufficient force to crack the steel hearth shell. So, essentially what we are saying most siliceous like we really do not want to have any lime in this slag because, when you put the water in these.

So, calcium oxide to the parters keeps you calcium hydro oxide and that because explained even such gas together of all cells with their and due to the expansion of that I exert the force so forth. And when there is a plenty of lime in there that force could be of sufficient force and it can even cracked as the steel hearth cell and sometimes even the small explosion occur, if that falls is not taken care in a proper way. So, it is very essentially step that as much as possible the lime should be removed by end of the blowout period.

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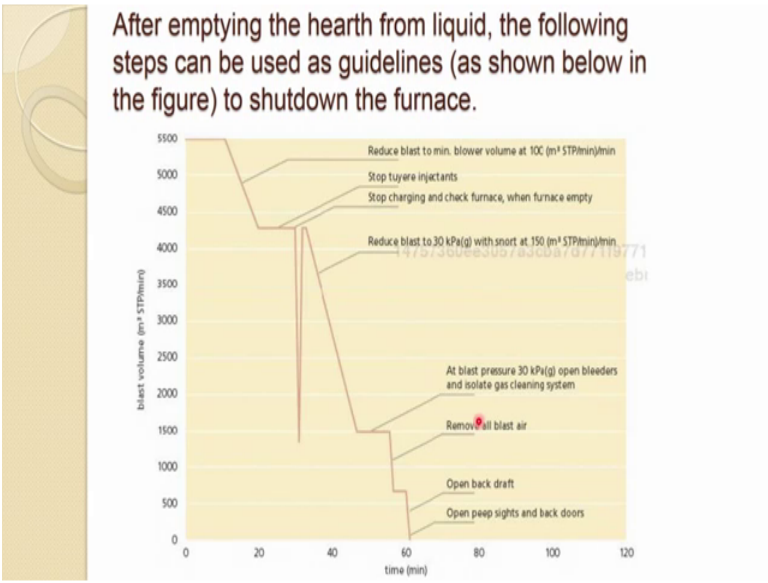

These are some of the figures which saw this operation which we had discussed previously. So, after emptying the hearth from liquid the following step can be used as guidelines.

So, as shown in blow in and the below figured to set down the furnace. So, reduce the blast when you are setting it down to minimum at 100 meter cube per minute, then somewhere up to half an hour we stock the tuyere injectant. If you are having a oil fuel or the gaseous fuel or PCI anything and then you stock that 1 I stop charging and check for furnace when furnace is empty, the when the furnace is empty then almost after 35 minutes you start reducing the blast to thirty kilo Pascal, which is not at a 150 meter cube firmly.

So, a blast pressure when it reaches 30 KPA often bleeders and isolate case cleaning system remove all blasters open back dropped open peep sight and break doors and that is way when things are over, this one can say furnace has been shut down and other operation can be started.

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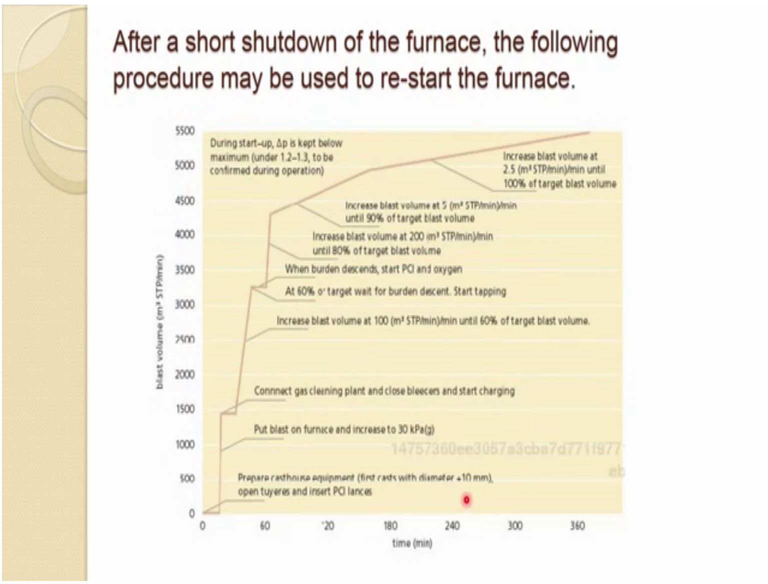

Similarly, for short shut down if somebody wants then the following procedures may be used to restart the furnace. So, this is after resort sat down like dropping or banking and then how to restart the furnace. So, opened tuyeres and insert so this is after tapping out all the material things you are starting again from their time. So, open tuyeres and insert PCI lenses prepare cost house equipment first cast with diameter plus 10 millimeter put blast on, so this is happening your within 10 to 20 minutes. So, put blast on furnace and increased to 30 KPA connect case cleaning plant and closed bleeders and start charging

Increased blast volume 200 meter cube per minute until the 60 percent target is reached by 50 minutes or so at 60 percent target wait for the burden descent start tapping when burden descents start PCI and oxygen at that time and increased applied volume to 200 meter cube per minute, until 80 percent of target large volume is reached which is usually achieved in an hour or so and after that you increase the slowly the blast volume with 5 meter cube per minute until the 90 percent of target judice in sort of 2 and half hours and then you increase the blast volume very slowly after that to 2 and half meter cube per minute until the 100 percent target is reached on the blast furnace.

So, which if you look at the minute it can take about 6 hours or so in 6 hours you can bring and the furnace again to the normal operation or say 6 to 8 hours when it is shut down for a short period of time and this we have you have seen these fun figures that after realigning of flowing, what sort of how the silicon content and hot metal temperature vf in this 1 you have more parameters.

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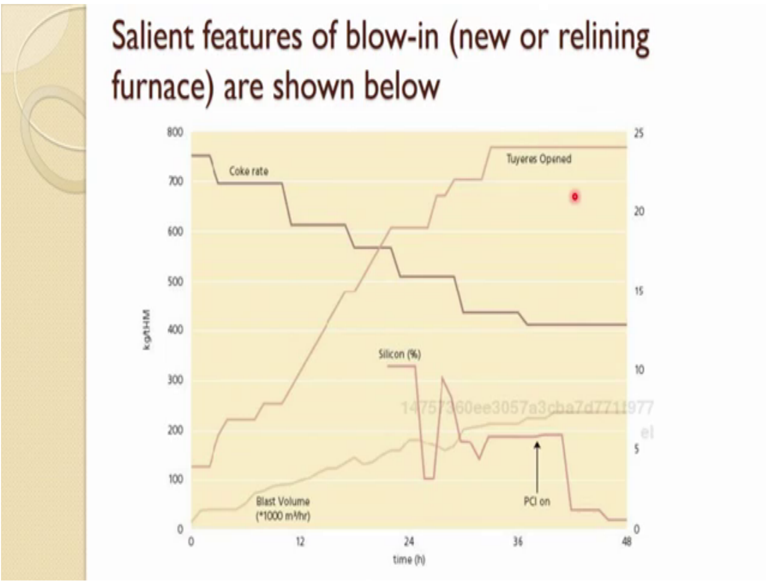

So, one is the blast volume and time is given in hours. So, in 2 days you can see the blast volume which is going with thousand meter cube per hour it goes in forty hour 48 hours to the normal one and similarly your silicon percent content also fluctuate and reaches to it is a normal silicon percent content your tears open slowly and reaches it to the normal operation and coke rate is also from very high 750, then it reaches to almost 420 410 kg per ton of hot metal.

So, when these sort of target values are reached, then 1 can say the furnace head achieved the normal operation which takes almost 2 to 2 and half days. So, this is this is all about the how to start the furnace, how to set down the furnace, how to stock the furnace in between and then how to restart the furnace in between. So, it can take care of various situation various conditions which are occurring during the plant and it is important to handle all these problems. So, now I hope you understand how these operation works in different conditions.

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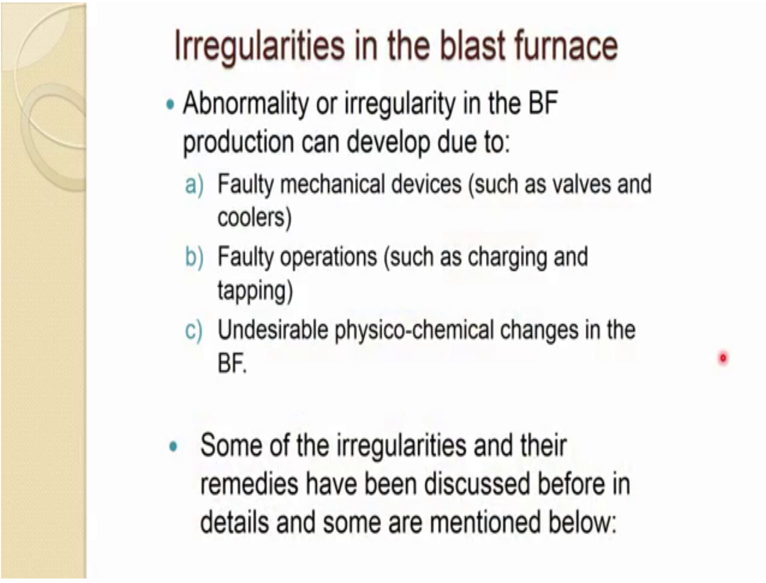

So, after this we will move on to the another important aspect of the blast furnace, it is about the irregularities in the blast furnace; this is again a very important thing to know in the blast furnace what are the irregularities. In fact, many of these irregularities we have talked during the span of this course at various stages and. So, some of the things will not be repeated here some might be repeated and something which are new would be discussed in this 1.

So, abnormality or irregularity in the blast furnace production can develop due to either faulty mechanical devices, yes such as ball cooler or faulty operation such as charging and tapping or undesirable physico chemical changes in the blast furnace. So, it can occur by any of these or with the combination of these and when that happen do you fit the abnormality or irregularity in the operation of the blast furnace. So, it I mentioned some of these irregularities and their remedies have been discussed before in detail. Some are mentioned below some have been repeated.

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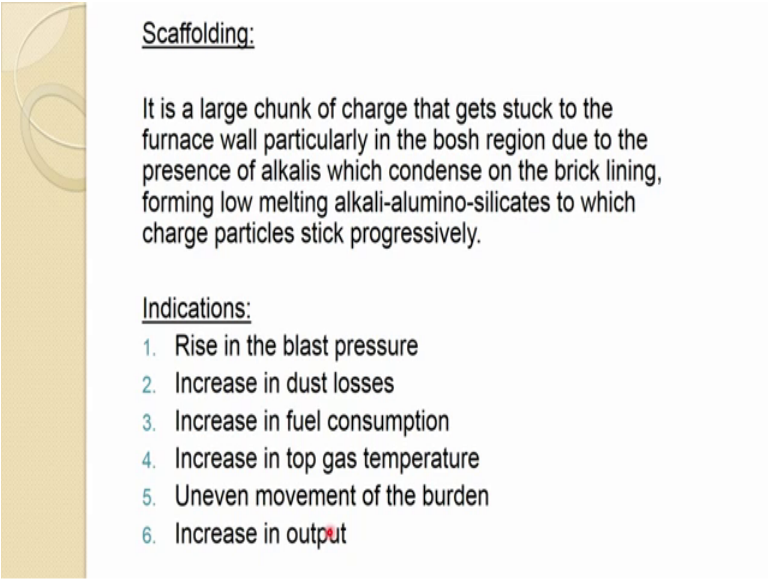

So, one important irregularity is about scaffolding. So, it is a large chunk of charge that gets stuck to the furnace wall particularly in the bosh region due to the presence of alkali, which condense on the brick lining forming an a low melting alkali, alumino silicate to which charged particles stick progressively. So, this is mostly caused by the presence of alkali and because when you are charging the furnace fines are also generated and things and when this material becomes quite soft these fines and other thing can accumulate on this and then it progressively increases in size.

So, but a presence of alkali the main reason of having accretion our development and due to this brick lining, so indication of this because it is increasing progressively naturally rise in the blast pressure increasing dust losses, increase in fuel consumption excuse me, increase in top gas temperature uneven movement of the burden increasing output.

So, essentially the scaffolding is also reducing the area not the furnace. So, if these things are happening this gives an indication that a scaffolding in happening somewhere in the blast furnace and one has to look at all these things and take the corrective action.

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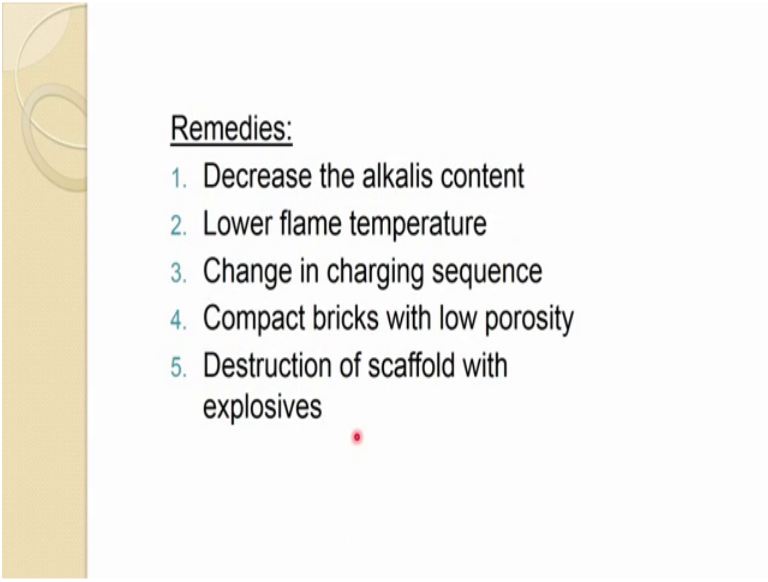

So, what are the correct action for this decrease the alkali content, which comes mostly from the coke or sometimes be some more. So, low alkali content material must be charged lower the flame temperature good why that one is vaporized and then goes up and condenses near that. So, lower the flame temperature change in charging sequence compact bricks with low porosity.

So, brick lining should be a much compact with a low porosity that they cannot be attacked by alkalis. So, that is opening will not occur and finally the destruction of scaffolding with explosive, when it does not go then explosive has to be used to remove the scaffolding; so these are some of the remedies by which a scaffolding can be reduced, but because alkali is the most important factor.

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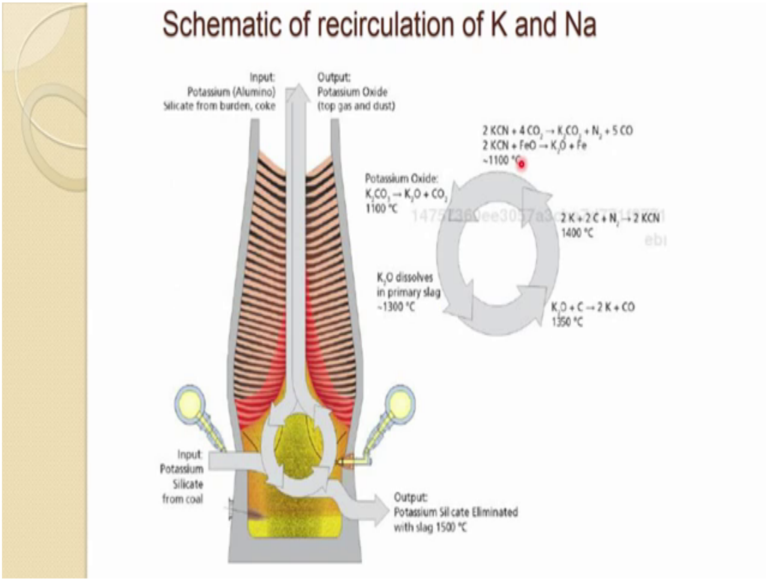

So, this slide shows how the recent circulation of alkalis occurred though we had discussed this 1 in us in our previous lectures in the starting, but here we are again discussing and giving a little broad view of it. So, this is the here is the example of potassium same thing is applicable for the sodium. So, input potassium silicate from the coal.

So, from a coal actually the source and even the coke so when and then they react. So, K 2 CO 3 which is coming it actually at this temperature around here from K 2 O and K 2 can dissolve at this boundary because, this is just a starting of the melting can dissolve with the slag actually at 1300 degree Celsius and also this 4 K 2 O coming here.

So, it can actually become an elemental potassium almost at 1350 degree Celsius and some our sodium element and this is a like a vapour. So, it is vaporized vaporize and so here temperature becomes low it condenses here, goes with this slag again it is coming and vaporizing and some of this potassium or sodium it is combining with this slag. So, comes out with this slag a bit and some of them it is going out and naturally it is some of them if the flow is not proper some of them they are take the re factories over here, high temperatures zone they can found the that silicate low melting silicate by reacting with this and they fines which are generated they stick to it and slowly this increase in size.

So, it can increase in size and if then it will obstruct all the gas flow reduce the volume, the temperature will become higher as we had mentioned in the previous slide and sometime it can also because nitrogen is always there, it can form the cyanide and that cyanide again react with the CO2 in this region in the stock region and it forms go back to K 2 O and into K 2 O the and then K 2 O. So, naturally if you look at that one, one way of reducing it, if you can have a central gas flow. So, from the top cases it can from the center it can go out to the top cases peripheral flow will take the bricks and then more of a scaffolding promoting that in that way.

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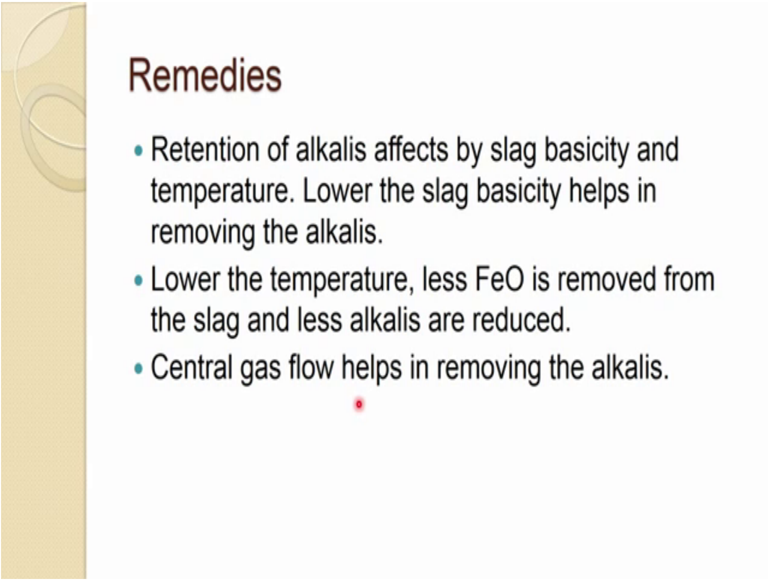

So, some remedies are again retention of effect by select basicity and temperature. Now, lowered the slag basicity helps in removing the alkali, but remember you of the slag basicity sulfur content is dull to depend. So, one had to make a judicial storage of the basicity and lowered the temperature less FeO is removed from the slag and less alkalis are reduced. So, now here 2 conflicting again the things to load lower the temperature then FeO is removed from this slag would be less. So, they were losing more FeO over this slag on the other end the alkalis are not that much reduced. So, they go with the slag and they can be removed.

So, again a optimum or compromise had to be made between these 2 and see. However, when alkali content has increased probably that time and you may go for the lesser fuel removal because you want to remove that and then again you can start or resume the normal operation of the blast furnace and central gas flow helps in removing the alkali.

So, as I mentioned in the previous slide if it is a central gas flow by changing this charging and other ways you can achieve this which we had discussed before, then you can reduce the alkali content in the charge and thus you can minimize the scaffolding of it.

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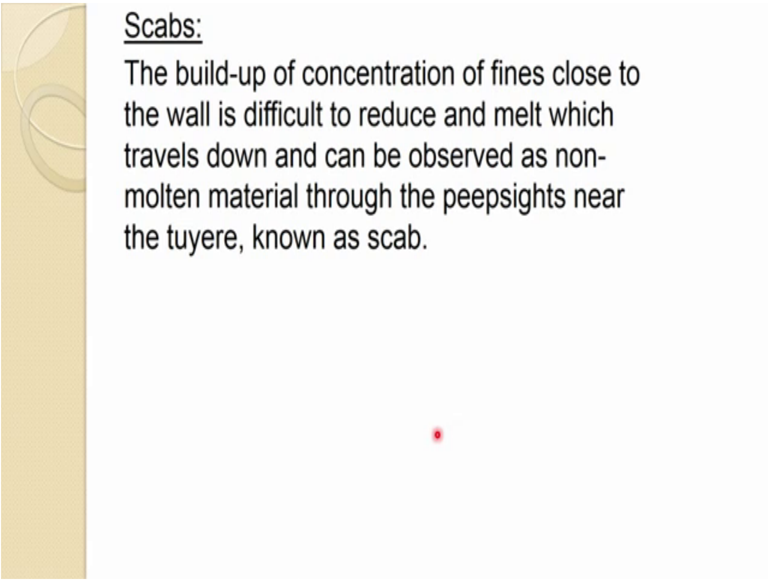

Another the 1 is escapes the buildup of concentration of fines close to the wall is difficult to reduce and melt which travels down and can be observed a non molten material through the peep sights near the tuyere known as scab. So, essentially what it is when you are charging the material when you are charging the material if it is heating the wall it will generate fines more fines and that fines get accumulated as a sort of a material chunk and because this is very fine, so porosity is less.

So, the reducibility is also less then that one actually travels down with the charge travels and if it is not melt melted and reduce further as it is going down which is quite difficult, because it is a very fine material sometime of course, this kind a stick to the scaffolding and sometimes travels down and travels down up to here this is kinetic saws actually.

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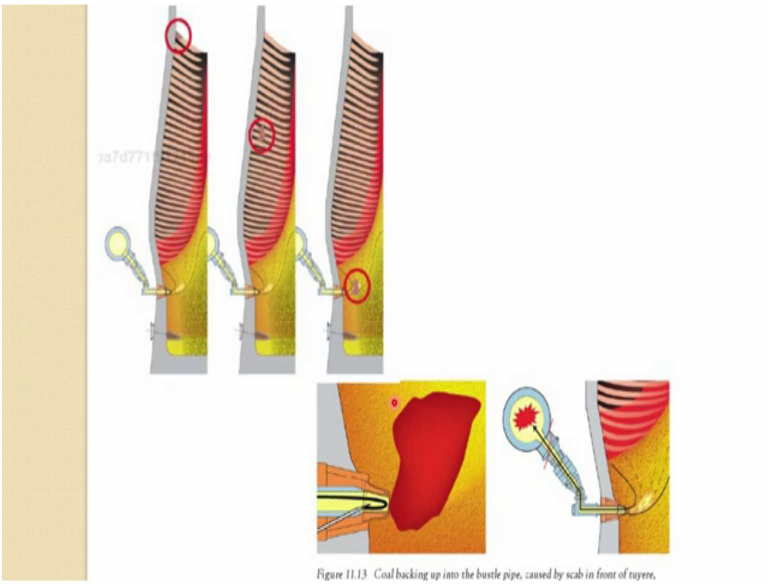

So, here the buildup of those fines which is traveling down I had not reduced much and finally, it is in melted and rigid that much it has reached today tuyere region and in probably in front of the tuyere and that is a big mass chunk and it is blocking the tuyere, sending break whatever is coming from the tear and that creates a danger situation and some explosion may occur in the past about the pipe. So, these things happen sometime if this is not taken care in quite dangerous. So, the remedy of that indication is increasing the flame temperature non uniform gas distribution it releases locking 1 of the 2 years.

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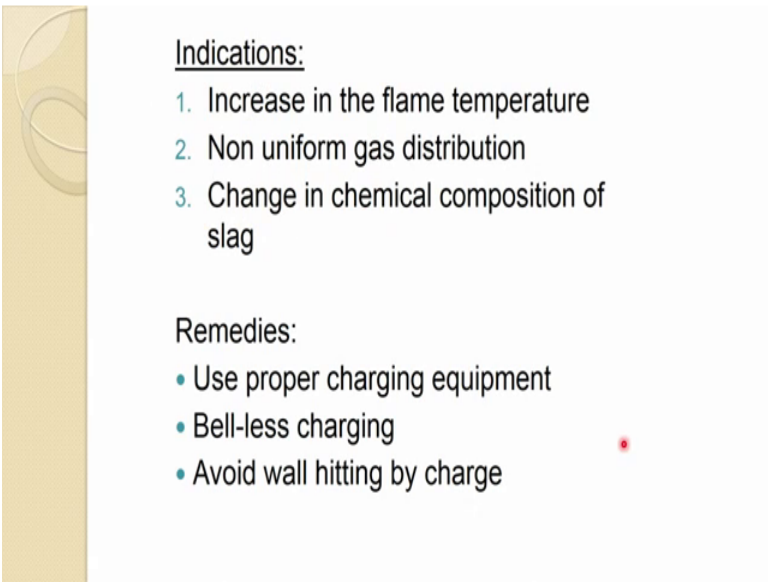

So, there would be non uniform distribution changing chemical composition of the slag. So, remedies use proper charging equipment bell less charging avoid wall hitting voltage charge. So, bell is charging actually gives you this advantage that it does not hit the wall. So, less chances of creating the fines and so mostly it is more about the quality of the charge should be strong enough and the proper charging equipment should be used starting from the storage bin to dumping it.

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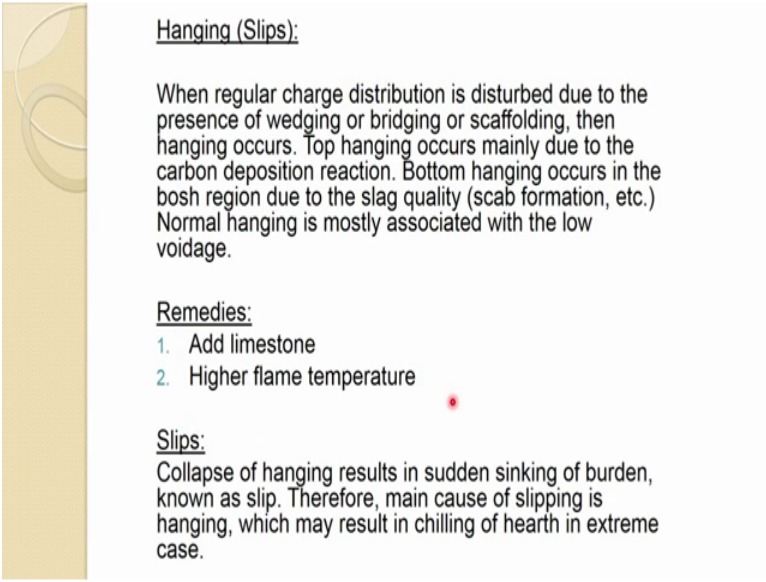

Another abnormality is hanging that is slips our hanging and slips these are 2 thing I said that we will discuss because they are related. So, when regular charge distribution it disturbed due to the presence of wedging of bridging or scaffolding then hanging across.

Top hanging occurs mainly due to the carbon deposition reaction, see the due to that we discussed this 1 solution loss reaction where the carbon deposition occur and that carbon deposition when this occurs, it endure the descent of the charge so and this may occur in the top section. So, top hanging occurs mainly due to the carbon deposition reaction bottom hanging occurs in the bosh region, due to the select quality is kept formation etcetera normal hanging can occur anywhere where you have a low voidage.

So, when logo it is not there anywhere that normal hanging, can occur remedies add more limestone are flame temperature in this one I this I am not also talking much because we have talked about it. In fact, we have discussed with some of the figures also how this bridge is forming and hanging is occur and below this void is place is created and when it is unable to withstand that pressure suddenly the whole chunk is slipping down and that is where the slips comes. So, collapse of hanging result in sudden sinking of burden on a slip. Therefore, main cause of slipping is hanging which may result in chilling of the hearth in extreme condition an extreme case this can happen.

So, this is very important and that hanging and slip and we had discussed these things before. So, I am not discussing much you can go back to some of those slides and can have a look at it another abnormality is about the chilled hearth.

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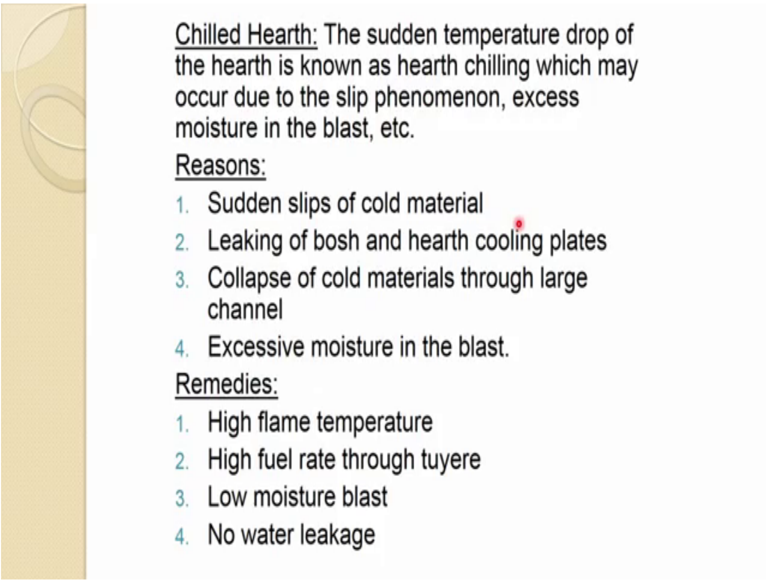

So, just now we say in the slips extreme condition, it may happen that due to slipping of the chunk mass it can fall into the hearth and hearth ceiling can occur the sudden temperature drop of the hearth is known as hearth chilling, which may occur due to this slip phenomena excess moisture in the blast etc.

So, regions are certain slips of the cold material leaking of bosh and hearth cooling plate that is also very important and very often it happens. Collapse of cold material through large channel excessive moisture in the blast, if excessive moisture in the blast then to temperature reduces and which also results to the chilling of the hearth remedies high flame temperature 1 should have high fuel rate through tuyere, low moisture blast no water leakage. So, properly sealed these are the sort of some remedies of chilled hearth.

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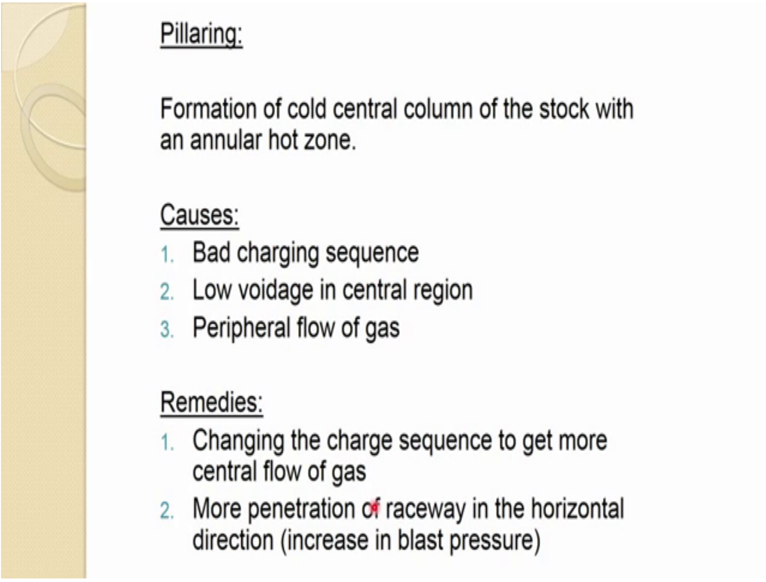

Another one abnormalities or irregularities is blurring, so formation of cold central column of the stalk with an annular zone of annular hot zone. So, this is either if we go back to here this is mostly if so this center region has a less void age the indebt, the charging something such that you have a less voidage here then the reduction and heat transfer would be low here and this form like a pillar here and that is what which we are talking about. So, it is a bad it causes due to the bad charging sequence low voices in the central region peripheral flow of the gases. So, remedy change the charge sequence to get more central flow case more penetration of rays were in the horizontal direction.

So, that it is increase in blast pressures which when you increase in the blast pressure. So, raceway the ray way penetration will increase more in the horizontal direction which will promote the central gas flow. So, that will help in better heat transfer and mass transfer. So, that may not occur and one of the reason of hearth chilling because, when that mass becomes very high suddenly it can collapse into the hearth and hearth chilling may occur.

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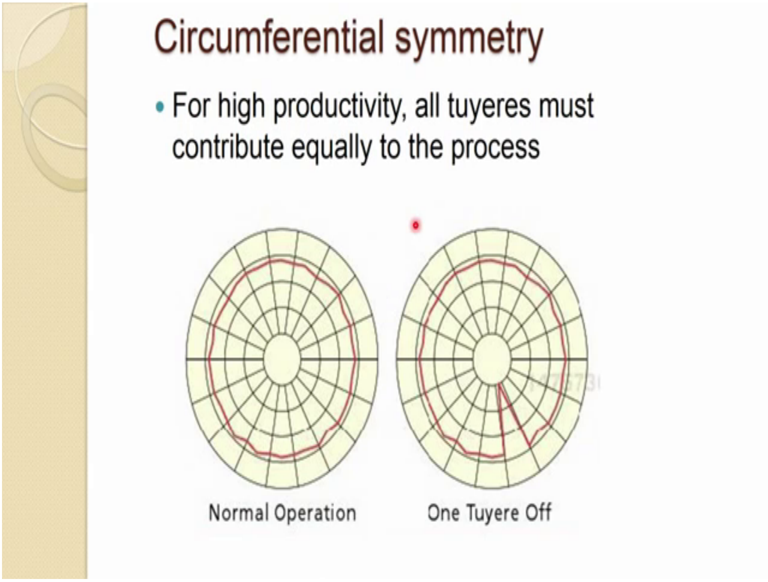

Another one is about the circumferential symmetry this is one important one again for high productivity all tuyere must contribute equally to the process. So, this is figure saws 1 normal operation where all the tuyeres are operating and you can see a very good circumferential symmetry in our respect now in this figure 1 tuyere is off suddenly as you can see the imbalance over here. So, this that is the tuyere which is off, so that is giving a quite an even circumferential symmetry and that is going to create quite a bit problem one due to an even of this symmetry you can have an asymmetry cohesive zone.

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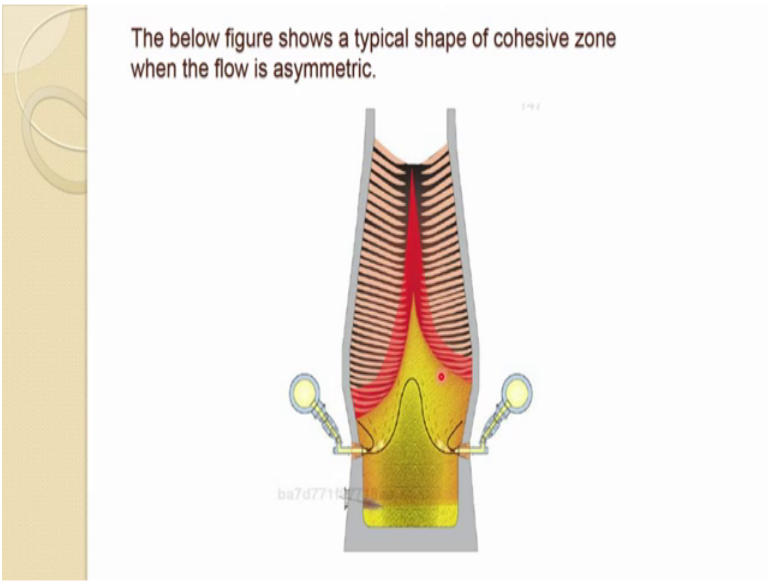

So, the at one side has a quite low other side has higher side. So, this is again it is going to create a big problem in the running the blast furnace a smoothly.

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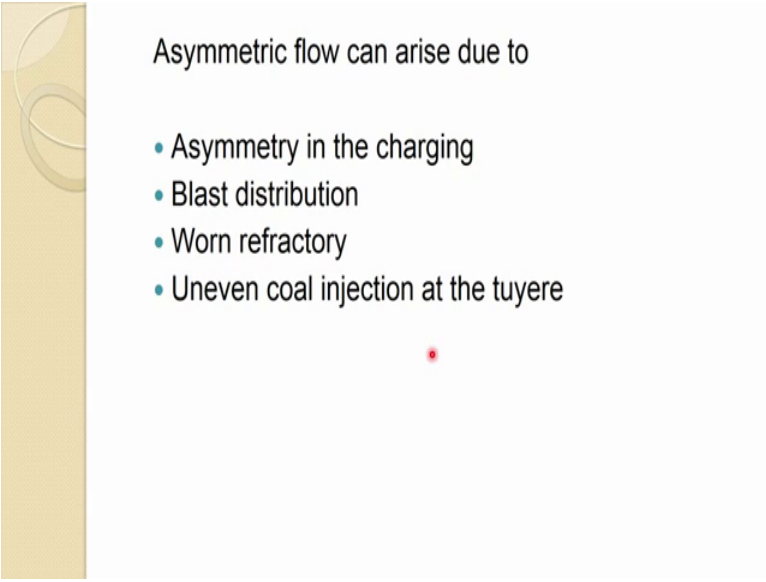

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And so a symmetric flow can arise due to asymmetry in charging a large distribution, worn refractory uneven call injection a deteriorating at 1 tuyere as you are injecting 50 kilogram pattern of hot metal and from another one you are 200 kilogram per PCI per ton of hot metal and that is uneven call injection is going to lead the asymmetry problem in the blast furnace.

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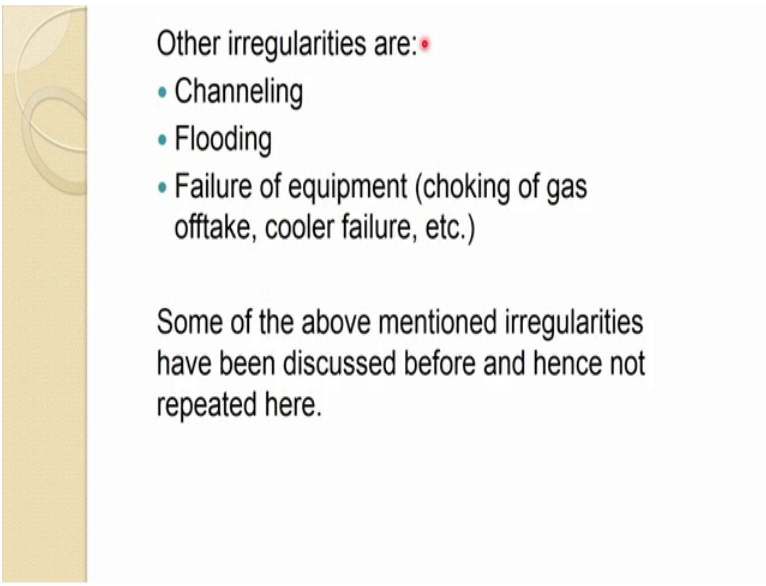

So, this whole thing must be taken care off in a proper way other irregularities, which are there in the blast furnace channeling flooding failure of equipment like choking of case of take off take cooler failure then of course, not talking mechanical side of the things anywhere in this course, so this is another different sort of phenomena which is not much related to the iron making process. So, this is more to mechanical failure and other things.

But the channeling and flooding is very common phenomena which occurs and fluidization and this we have discussed in great details in some of the lectures, supposed to go back into that and try to understand channeling flooding fluidization loading all those things because, these are very common irregularities in the blast furnace what we had discussed previously irregularities, because that anytime anywhere can occur and that can lead to uneven operation of the blast furnace.

So, some of the above mentioned irregularities have been discussed before and hence not repeated here. So, I would suggest please go through the previous lectures and check this one because these are very important irregularities and which very often occurs in any of the blast furnace and how to remove those irregularities or how to correct that that is also discussed in those lectures.