Marine Construction & Welding

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Module No. # 01
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Shot Blasting

So, continuing with plate preparation; we had been talking about the heel effects of mill scale, if we do not remove them. Thereby, you saw that some methods should be employed such that this mill scale is effectively removed. Some of the methods which we have talked about appears to be not very effective because we talked about natural method that is, naturally the mill scale gets de-scaled rather it heels off.

Thereby, it is difficult to ensure 100 percent removal and also it may lead to local corrosions in the plate. Next method we talked about is the flame treatment. Flame treatment is nothing but you take advantage of the difference in the thermal expansion of coefficient of the plate and that of the mill scale.

So, if you are subjected to certain kind of control heating for example, you a gas flame a gas burner and heat it then, it is expected that the mill scale will peel off, because it expands more compared to that of the steel and thereby it will get loosened and it will peel off. That is somewhat better method compared to your natural process because it is much faster, but again the method is not very effective I would say, because here it involves control heating.

Now, control heating means what? That means, you will have to ensure that you do not exceed certain level of temperature in the plate, because if you do that the plate gets subjected to probably undesirable thermal cycle. You are heating it means what? You are subjecting the plate to a thermal cycle, it is getting heated up and then cooling down. So, we know if the plate is attending that gets beyond certain critical temperatures there can be damage of the metallurgical properties that means, so called micro structure may get affected.

At the same time it may cause deformation of the plates, we have already straightened the plates passing it through roller we have tried to eliminate the residual stress if any, but this thermal process apart from damaging the micro structure means, affecting its metallurgical aspects may also cause some thermal stresses to develop in the plate leading to deformation or leading to locked in stresses means, formation of residual stresses.

((Student talks))

Well, that is definitely possible but in the process what is happening if we assume that we are using this method then, we can do the straightening method later - that is possible definitely. Here, again the question remains thereby, we can sort out the problem of residual stress if any, which is forming or the plate getting deformed that can be sorted out but the problem remains that it is difficult to ensure full removal of the mill scale - 100 percent removal of the mill scale. That problem remains so once again you see that this method is also not a very effective method as such.

Next method which we talked about was some kind of mechanical means that means, by wire brushing, simple manual brushing would not help much because the bondage is very strong. So, it needs to be some kind of pneumatic brushing or the entire brushing mechanical operations has to be done under power. This is somewhat little better, effective wise better compared to the previous method, but you can well imagine how process would be whatsoever if it has to be applied manually then, not only it will cause lot of noise pollution also or in other words, not only it will cause lot of dust pollution it will also cause noise pollution. Means, the operator will be subjected to a very bad environment, it will generate tremendous amount of dust along with that tremendous amount of high decibel noise.

Well, we are talking about that these are some of the means at least you can remove some part of the mill scale; we do not have anything better. Till now, we have seen that all these are not very capital intensive processes; it is rather being done with very simple hand operated tools, the heating is by a gas flame. So, as it is you will be having oxidizing flame or oxidizing gas for cutting requirement, so with that it can be heated. You will need different kinds of nozzles of course. Mechanical brushing, some pneumatic brushes can be used but still the problem remains that they are not effective.

This gives us another aspect that this process of mill scale removal has to be made automated. If you want to make the process faster as well as make it more environments friendly, it has to be made in such a fashion that it does not lead to dust pollution, because dust pollution is very bad - I mean - it is a terrible hazard for the workers cannot effort to have that. Second is, the noise has to be eliminated that means, whatever method we use it has to be some kind of automated method then, automatically what is happening, the worker is not getting involved; he is not subjected to that dusty and noisy environment.

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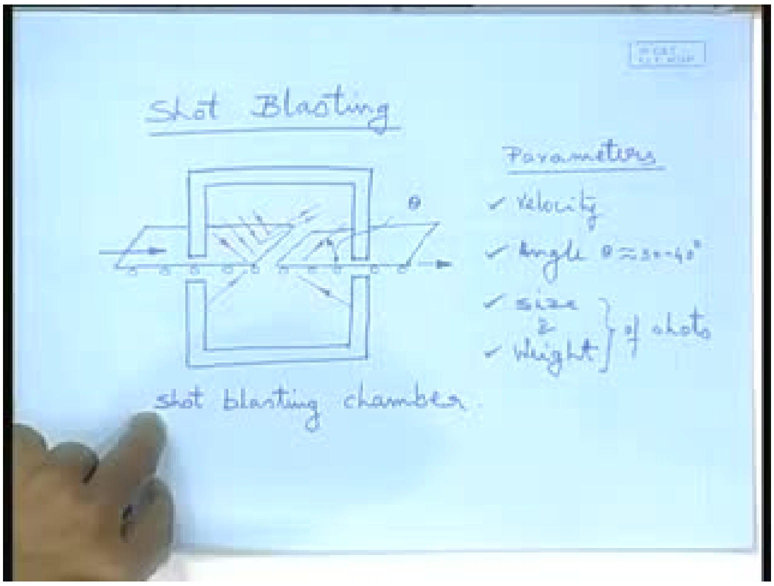

So, there we came to the method of shot blasting; it is also another mechanical method, so we call it shot blasting. If you see schematically it is something like this. As you can see that here the plate enters from one side of - say this is schematic description of the shot blasting chamber. Here, the plate enters the chamber moving over the roller conveyors - these green small circles indicate the roller conveyor. After the plate is coming out from the straightening machine on the roller, straight way it is put on and the same conveyor line goes, so it enters the shot blasting chamber.

So, by putting it within a chamber what you can see is that you have a sound insulated chamber suitably covered. Automatically, what is happening? Whatever is happening inside it does not affect the environment outside. So, what is happening inside is, as the name suggests shot blasting that means, the plates are blasted with steel shots.

Schematically, I have shown it here with this red arrow that means, you can have 4 jets. Blasting the shots over the entire breadth of the plate, here you have shown a cross section, so this over the entire breadths of the plate suppose, the plate breadth is like this.

Over the entire breadth you can have - I mean - there will be a suitable mechanism of shooting these steel shots over the plate surface from both sides. So, what is happening? The plate keeps moving and it is subjected to a high energy blasting of steel shots. In the process what happens? What are these steel shots? They are small steel particles, something equivalent to that of small ball bearings; if you break such small particles it will have some sharp edges.

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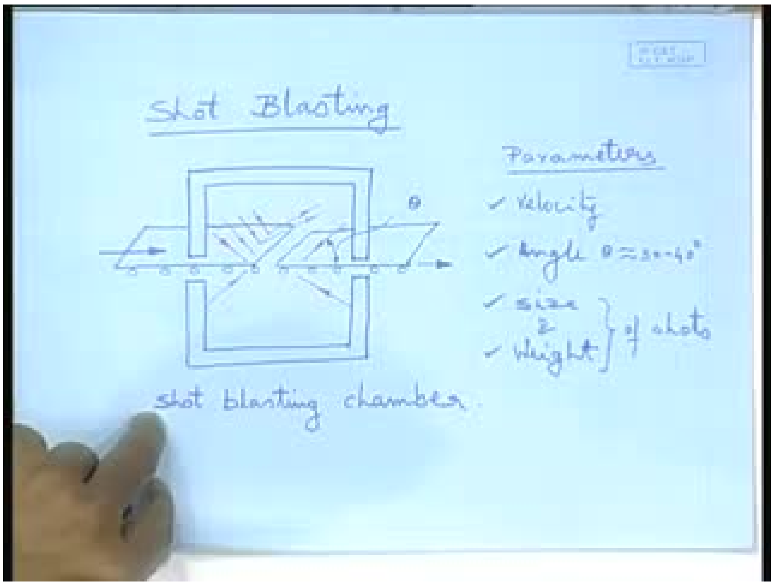

So, as it is improved on the plate surface what will happen? It will hit the plate and will get reflected back. In the process what it will do? It will chip off the part of the material on the surface there by, as the plates keeps moving from both sides, I am blasting the surface on the top as well as at the bottom. So, the shots are coming hitting it and getting reflected out, while it is going each particle is taking out a small chip of the plate surface material and the surface material is the mill scale there by it is cleaning it.

Now, the question comes how do I ensure that it is really taking up the 100 percent of the mill scale, because it can be something like this, I just crib it out. There is 10 micron thickness layer is there, I scrap only 5 micron and 5 remains or I scrap in such a fashion that I scrap of 15 microns, so not only the mill scale goes but also the steel material goes.

These are again called drawbacks or called aspects which are to be looked into while setting the parameters of the machine. So, what would be the parameters? Parameters would depend on how much energy I must impart in those shots, such that it should be able to chip off the material. At the same time I do not impart too much energy that it chips off to a greater depth. Thereby parameters, if we try to quantify there will be velocity of these shots; this shots are generally, it is done by that there is a impeller kind of thing.

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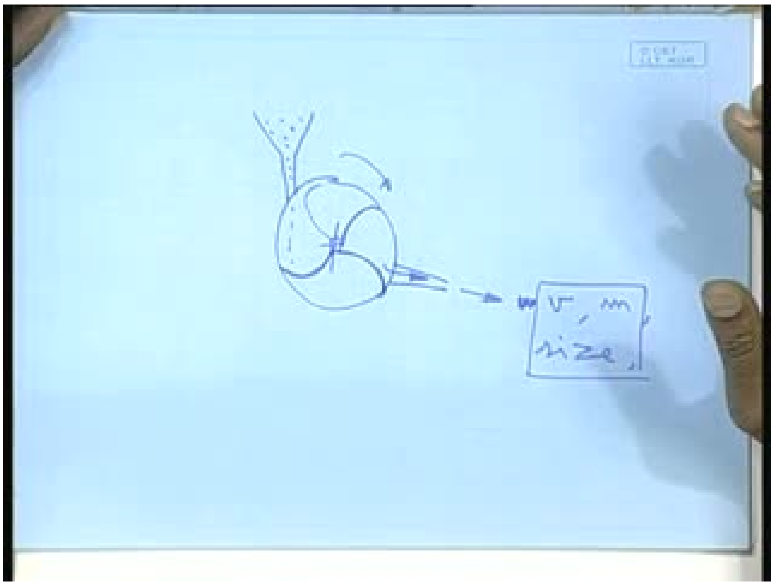

Schematically it is somewhat like this, you have an If we just think in schematic term this is a hopper where the shots are kept, it falls on this impeller here, what I have tried to draw is a impeller having blades like this. It is rotating at a certain rpm, so what will happen? It will impart energy in the shots and where it comes and exit out at a high velocity.

So, at what velocity it will go out will depend on the rpm of this impeller. So, eventually we are interested on the velocity of exit of the particle, its mass and its size. In fact they are the three basic parameters which are interested in, because this will give me that with what energy it is coming and hitting the plate and depending on this energy it will do the job. Means, either it will chip off a part of the mill scale or chip off exactly as you want or chip off more, so there by we see that, this is just a schematic representation of how it works.

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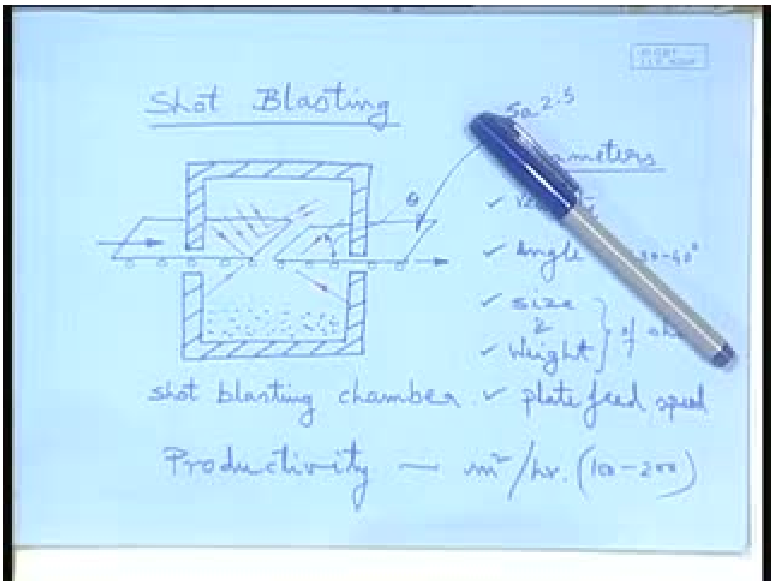

So, we will have parameters like velocity and another parameter of course, like at what angle it is being shot at the plate surface. This angle theta that means, at what angle you are blasting it, here the way I have shown. We have four sets of shot blasting unit, one from this side top and bottom, another from the other side top and bottom such that to ensure full breadth of plate both top, bottom and side perfectly removed. Another important parameter is, the angle at what you are shooting it on the plate and definitely the size and the weight of the particles shots. So, these are called parameters are to be controlled such that, we ensure 100 percent removal of the mill scale.

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Yes, as far as the process is concerned, as it is done then all your shots will get accumulated here. Shots which are getting reflected that means, shots along with the dust and along with the mill scale powder - because it will be in powdery form - will get accumulated at the bottom. So, we will have a mechanism of filtering it out and recycling back the shots, so the shots are recycled. Obviously, in the process some of the shots will lose its character; character means, basically will become smaller in size, lesser in weight that means, they will also break - they will get worn out.

Time to time you will have to replace; whatever is getting lost replacement is to be done. So here, we see that the entire process is carried out within a chamber and also the fitting of the plate material, as well as taking out of the plate material everything is automated.

Automation is done through roller conveyor that means, after the straightening operation plate straight away moves into the chamber.

Chamber is closed, the only opening you have is where from the plate is entering and does edge where the plate is coming out. That opening is also covered by a flexible rubber like material which it is a flexible material thereby, the plate can push the rubber material and goes out but physical closing is there. So, this dust - I mean - very little one can say, hardly any dust comes out from the chamber and it is well acoustically insulated, so you also do not hear a big noise otherwise, it is a very noisy operation.

Noise is also confined in the chamber as well as the dust is also confined, so there by you make the process very much environment friendly, so that is what is the shot blasting. Here, we see that the rate of operation how fast we can do it that will depend on how fast we can move the plate that will again depend on. If we move the plate very fast then probably we may land up not removing the entire amount; we move it very slow, we may land up chipping of the plate. So, there is another parameter that is, plate speed or plate feed speed, at what speed the plate is being feed.

That also becomes another parameter which is to be controlled for proper operation of this - proper shot blasting operation. Also this parameter determines your productivity, because as far as the end user is concerned, he is not bothered at what angle or velocity or size or weight he is only bothered about at what speed I can move the plate, because that is my goal that I want to have this much of productivity. So, productivity of this operation is given in terms of meters square per hour. Again speed is not the exact productivity because to quantify I should be able to say that so many meter square of plate has been mill scaled - I mean - has been de-scaled or has been prepared.

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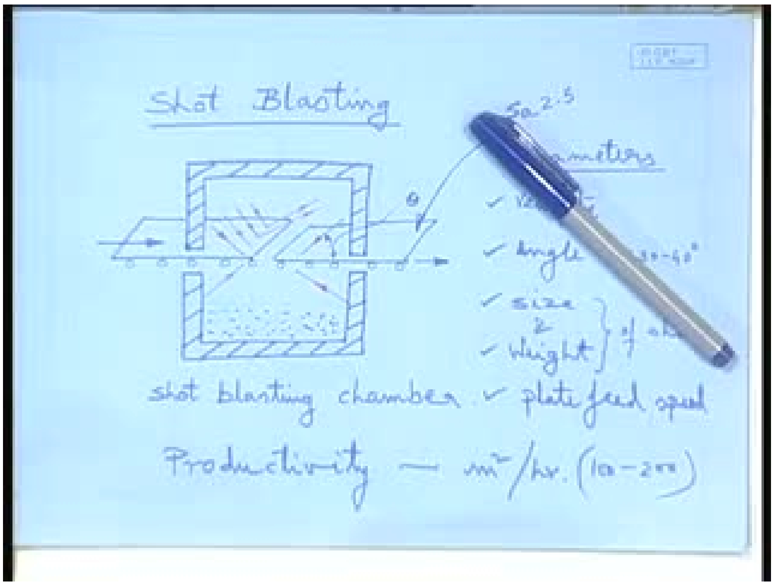

Productivity comes in terms of meter square per hour or how many meter square per hour it can clean. So, more or less these varies somewhere within 100 to 200 meter square per hour; 100 to 200 means depending on the kind of machine etcetera this may vary between 100 to 200; also depending on the plate thickness also this will vary. Though plate thickness is not a direct parameter which is to be controlled that is being given as a sort of that depends on what all plates you have and you have to clean it, but that has an indirect effect on these parameters rather as a direct effect on these parameters.

Can you tell me how plate thickness comes into picture? Because the whole operation you have seen here what is coming into picture is the plate breadth because, depending on the breadth I have to make the machine arrangement such that I can cover the entire breadth that is done because you know the breadths are standard here. We would not be doing that, like this time I put 500 millimeter plate and next time I put 3 meter plate, No. Standard plate's sizes are either 3 meter wide or 2 meter wide generally, these are the two standards forward. Shot blasting we are doing right at the beginning that means, you have the full size rectangular plates; we have not done any cutting operation yet.

So, that is done and based on that plate breadth and the speed I have the productivity meters square per hour, it is nothing but basically breadth into the speed of movement, Now what role thickness may have here or in other words if I ask, we have seen the previous methods of natural thermal etcetera they are draw backs, what you can think is the draw back here? As of now it looks quite a effective method and I can tell you that once we set this parameters properly then, we get the plate surface to our requirement that means, we can ensure 100 percent removal of mill scale also can ensure proper surface smoothness. We need generally a smoothness parameters of Sa 2.5 - that grade of surface smoothness are possible we can get.

The process is automated so your operation is very convenient; it is environment friendly the shots are re-cyclable, so everything is good what is bad about it? What to be something negative, there cannot be anything in this world which is always 100 percent good, has to be something bad. So, tell me what could be bad here or what could give us trouble or what could give us problem? Time; Time is, you see here if you talk about time previous all three methods what we have seen it is much more efficient here, the production is quite high.

Like for example, natural method production would have been fantastic, because six months you keep the plate flame heating, it cuts down very much, but there are other things that quality of the end product may not be as good wire brushing. Well again, its manually you are doing, so productivity will be less; speed of operation would be less and also hazardous. Here, speed of operation is quite fast that means, it has something to do with thickness that is number one; it has something to do with the surface hardening of the plate, because what is happening when you are blasting the plate with the shots, what operation it is? It is where heating with the high energy particle.

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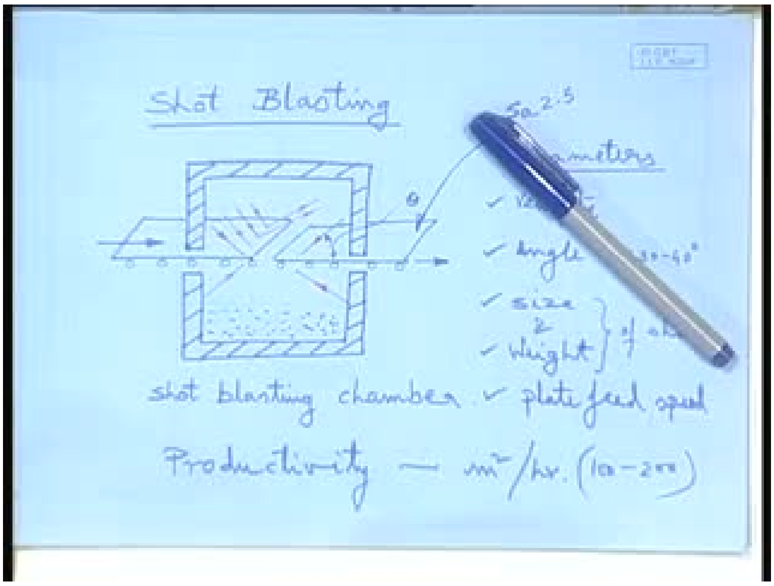

(( )) yes there can be a possibility of that shots getting embedded that generally does not happen. It will generate some heat because of friction but that will get dissipated; that will not affect, what will effect is that process of impact local plastification of the metal is taking place means, locally the metal stress is exceeding the heel point stress. It is something like what we called cold work. You know cold work? You take a hammer and hammer on the plate apparently nothing happens if you see the plate, but in that local area what has happened is, that solid if you can hammer what has happened is if you hammer really hard, then there will be a dent.

Suppose, the plate is lying on the flat surface, plate material will get depressed that means, a permanent set will take place, that is visible if you heat little less - that means - less but just above the yield point stress, but not much of strain is taking place. So nothing will be visible but the material there has undergone a strain equivalent to the yield point stress.

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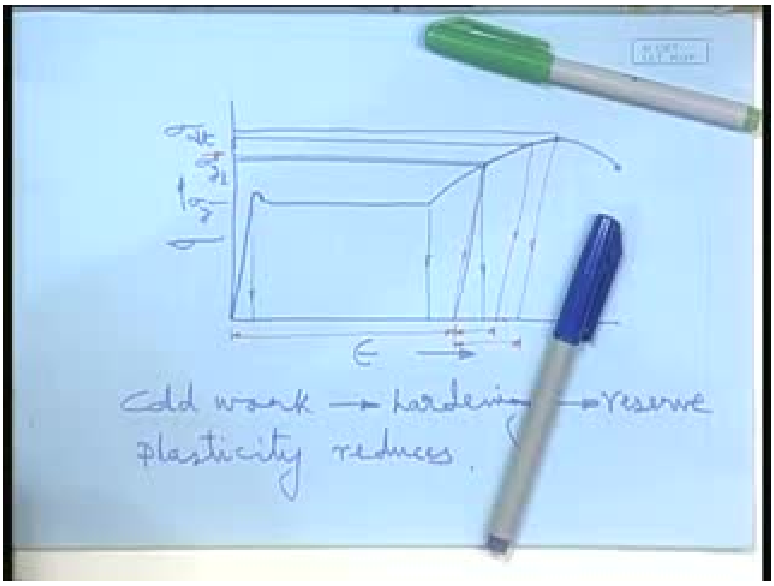

In other words, if you see here suppose, this is my strain and stress axis, your steel material has a stress strain characteristics somewhat like this. That means, till a certain stage it behaves elastically that means, it follows Hooks law. As you exceed that there is a small hump there, if you forget that hump, exceed that yield point stress then, you have a kind of a flat valley, that flat valley, the significance of that here as if under no additional load, the material keeps flowing that means deformation continues.

In other words, under delta increment of load the material will deform or in another words, once the metal has yielded will say that it has lost its load carrying capacity, because under a very small increment of load it will go on deforming, you can see the extent of deformation. Till such time your deformation was only this much and then, as beyond sigma y we have increase the load little more, than my deformation increases so much - substantial.

That is what the significance of this but again, we see that its start gaining strength, as if it is gaining strength. Means, we have said that as the material reaches yield point stress, it does not have load carrying capacity, but in real life it will not have load carrying capacity for a certain stretch - for a certain level - beyond that again, it will show strength. Means, again you need sufficient load, so as to effect deformation like here we are in need of sufficient load - sufficient stress level - here also then beyond sigma a again, you will have to increase the stress level such that you get some more additional deformation (Refer Slide Time: 28:47).

Here, also then beyond sigma a again, you will have to increase the stress level such that you get some more additional deformation. When you relieve the stress, release the load then what happens? Then material will come back to this state. This is called elastic unloading that means, this will be my permanent deformation. If I load up to this point this will be my permanent deformation.

Imagine a situation that you have loaded the material up to this point. It has showed some permanent deformation. Now, again you are subjecting the same material to some load, so what will happen, how it will behave now? It will behave in this fashion. It will start operating from here that means, it will behave elastically up to this point.

Now, its new yield point stress has become sigma y 1 and then, it no more has this valley. Then again, it will start gaining load, by gaining load why we use that term? Because this can be seen in a Universal Testing Machine, which is called UTM where, you subject space event to a tensile test - to slowly apply tensile test - so what you get? Load deflection curve, this is load deflection curve, because load divide by constant cross section is stress; deflection is incremental deflection divide by the length; gauge length is strength.

So, gauge length is constant, area is constant, load deflection curve is nothing but sigma epsilon curve - stress strain curve - so same thing will be visible. If I stretch and apply a tensile load to sigma y 1 position and then release the load that means, unload it then, I actuate the machine again and start applying load, what I will find next time is that it will behave ellastically up to this point originally.

Once, I have subjected to a cold work - there is a cold work in the cold condition I am applying load, so that is what is refered to as cold work - to sigma 1 level, unloaded it and again I am loading it, so it will behave up to sigma 1 has elastic and then immediately again start gaining load. At this point, this is my ultimate - stress sigma ultimate - at this point that necking starts, transverse cross section reduces. So, the curve apparently drops and breaks, snaps. Curve is dropping it does not mean that the load is reducing, it is essentially what is happening since the cross section is reducing, any way.

So what has happenned? What has happend to the material? Because of the cold work it has got hardened first thing, because its elastic limit has increased.

So, it has become a harder material, harder material means brittle material, so its ductility has reduced. Here, I can see the ductility as reduced because suppose, I loaded it up to only this, not to the ultimate point but just below the ultimate point.

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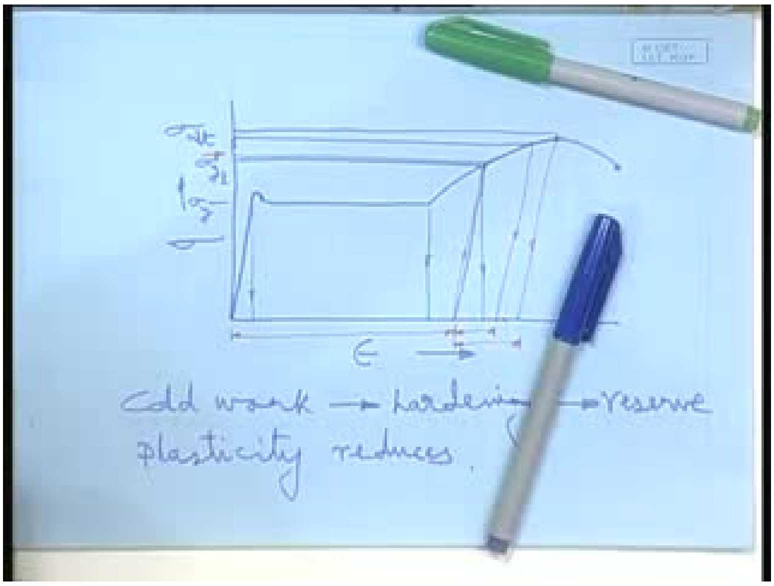

What happens now is I release the load, so always unloading process is elastic, so it will come back this much. Now, my deformation is only this much or in other words, this is my ultimate. So here, I can see my ductlity has reduced originally, my ductlity was this much, is nt it? If the plate would not have been subjected to the initial cold work we did, we seperated some tension and left it, again I am putting it on the tension. If I have not have done that initial tensioning, I would have a total ductility this much that means, the material was capable of so much of deformation before its breaking but, now the material is only capable of this much of deformation that means reserve plasticity reduces.

So, because of cold work it leads to hardening of the plate; hardening of the plate means, its tensile strength is increasing means yield stress is increasing. So, it is becoming more harder - stronger - but in the process, what is happening? Its reserve plasticity is reducing - reserve plasticity reduces.

You understand why this is happening, because this is my reserve plasticity you see that valley, this is a very peculiar property of steel material. It has a very quite long valley in the stress curve, which gives me reserve plasticity. Why it is important? Because I have to subject the plate that talks about ductility also, so that I can bend the plate, I can shape the plate. Not only that in the event of failure it will take lot of deformation before it fails like glass.

It will suddenly break, you would not get any hint but, if it is a ductile material; glass is a brittle material. If it is a ductile material then it will deform sufficiently and then it will fail. So, it will give you a lot of hints before failure that means, you have some earlier signals that the structure is deforming means well, it is going beyond its limit. That is why it is termed as reserved plasticity.

Once is subjected to a cold work it leads to reduction in reserved plasticity, so what is happening? That means, it cannot take much of deformation. If I subject the material to deformation larger than this, it will fail - it will crack. In another words, that if we do an experiment you have a steel plate, you go on hammering at the same location for quite a number of times. Suddenly you will observe the plate has cracked there; surfaces cracked because every hammering; first hammering I have done this hardening next hammering I am going beyond this (Refer Slide Time: 36:58).

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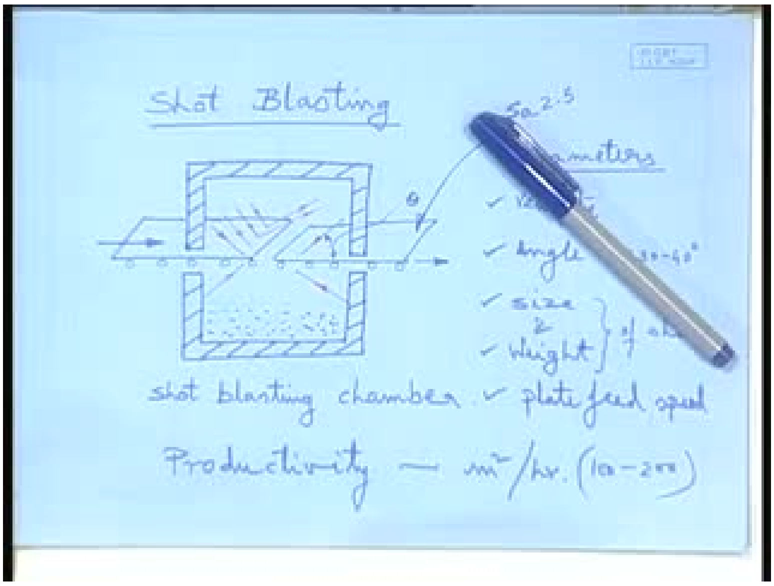

Again, it becoming harder gradually and you are exceeding the load every subsequent hammer. If I increase my intensity - magnitude of force - after some time I will find thus the cracks are developed in the plate. That means, that surface has become brittle it is cracked or you go on, you hammer for quite some time then take the plate and try to give it a bend shape; make a bend something like this, make like this, you will find it has cracked, so that is what it is. So, that is one of the bad point of shot blasting, because here you are heating it with those shots so that is working as at every small, small shots heating at with a very high velocity and with its weight the kind of kinetic energy it has or a kind of momentum locally the stress level may be exceeding the yield stress.

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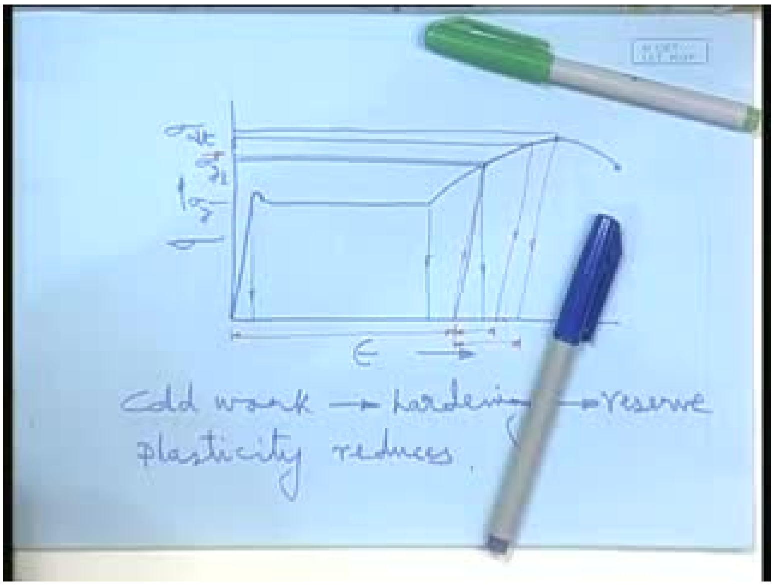

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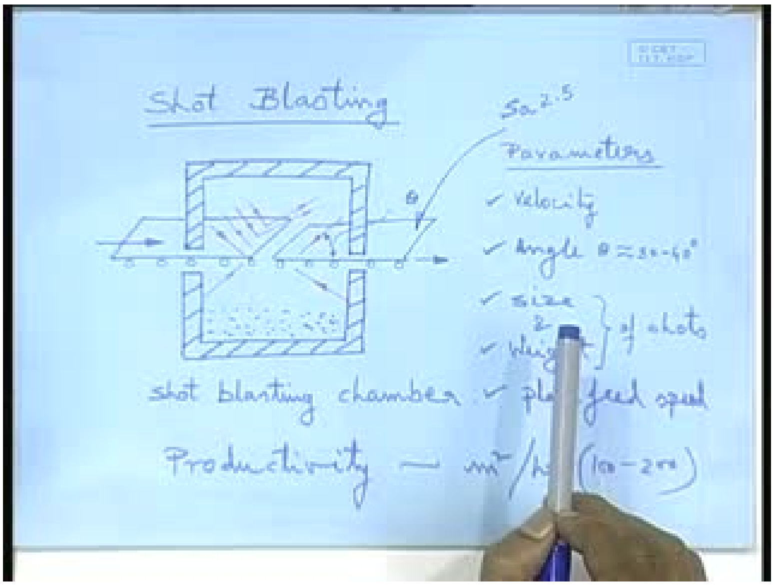

So that is also another thing to be worked out that it should not exceed yield stress. If it is below the yield stress no problem. That means, the material has not been subjected to cold work. I have done a cold work on it that means, some stress level having imparted but, if it is below the yield stress it will come back to original, means plates property has not changed it as remained. Here, the property has changed it has become harder, so there is also another aspect which has to be kept in mind, while deciding on the velocity as well as the weight of those shots, because that combination will give you the stress developing at that small points and those small points are closely spaced that means, the entire surface is subjected to that level of stress.

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Yes, these are the problems, so will have to keep this in mind, these are two contractory requirements; I would like lesser velocity, lesser weight, so that I remain safe.

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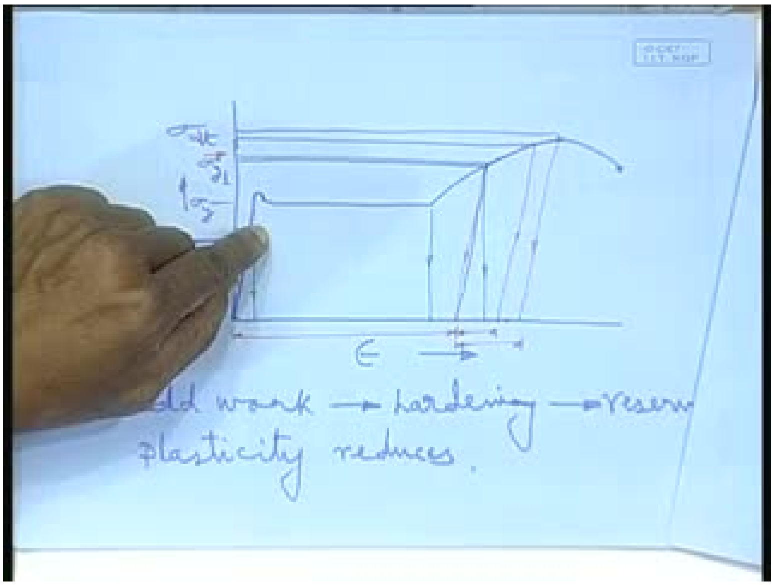

I am assured that it will not exceed the yield stress but, it may so happen if I do not do that then it may not chip off. Then again the question comes the type of those shots, the size of the shots, the kind of shape, the sharp edges, the angle all these comes into play, so what I mean to say is these are the features - factors - involved.

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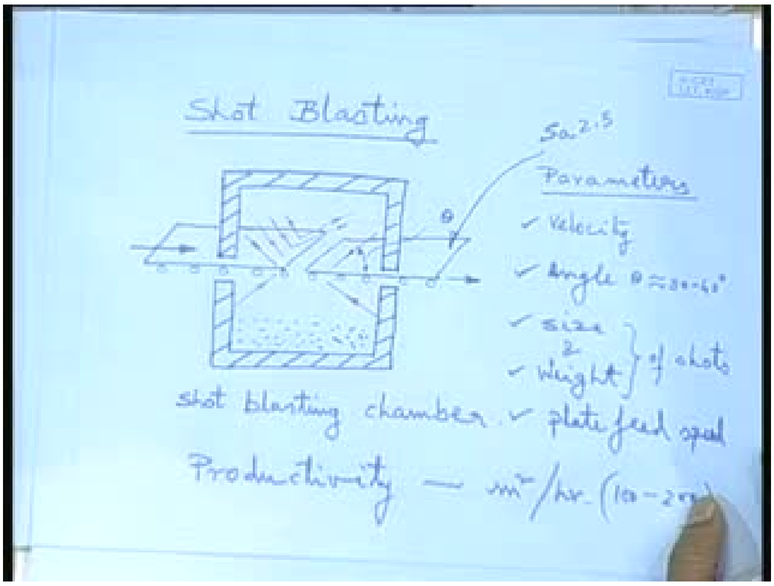

So, while designing the system and while deciding the parameters one have to keep these things in mind. Though, I am calling a shot blasting it will do the job perfectly but, whether it is leaving behind some damage to the plate that again, the purpose is observed because following these all kinds of fabrication work will go on the plate. Plate will be bend and you find it has cracked, airline crack is coming, because this hardening is taking place only on the surface.

The plate thickness is there only the surface is getting hardend; if you grind of the surface then again its fine but, that is not feasible. So that is actually one of the drawback of this process. There is one more drawback based on similar things what is that? That is on thickness. If the thickness is less this kind of work being done that may lead to stress level, not crushing it will tend deform the plate.

That means, if I put a 4 millimeter thick plate pass it through this and it will not sustain this kind of energy, which is being part on that plate and under that sort of blast of those shots the plate may deform, so that is another aspect. That means, if it is thinner plate then it may not be suitable for shot blasting operation to be done - may not be able to do.

So, one have to think whether we club 2, 3 plates together and put it together and go on changing then again that defines some other principle. That means, if we club 3 to 6 millimeter plates together it becomes 12, so it is some what harder, where they are in pinging with the shots it will not deform but, in the process what is happening, the internal parts are not. Once its comes out I have to take it back recycle taking back recycle is easy to say but, how do you do there? It is a process automated and it defines the basic principle of material handling that means, the plate is tracking back all together.

Its flow is this say from left to right and it is going from right to left these are certain general principle. So, material handling that it should be designed such that it should not track back material should not move back - I mean - that kind of principle one should follow and accordingly design. Reason is simple, you can well imagine if I have to track back the plate and fit it again it not only time it becomes very complicated issue, how do you make it flow like that because it is not a case of powder - I mean - the entire flow pattern changes that the entire thing becomes very complicated.

Well in other words, thinner plates it is not preferable in shot blasting, may be they are when you go for sand blasting but, again that the effectiveness may reduce and all that. So, these are the mechanical aspects as far shot blasting is concern. Now, once shot blasting is done, so the plate as it is coming out of the chamber we have a very bright shining surface; bright shining surface means, because steel otherwise is a very shining material absolutely shining bright material it is not at all a dull material.

When it comes out from the chamber it will give that shine, so from that shine you can make out whether it is confirming Sa 2.5 or Sa 1 or Sa 5 whatever, how that is done a very simple process. There are so called small templates, small samples, pieces of paper which has the similar texture as that of steel surface conforming to required Sa. This is some sewdish standard some how that is universally followed. What basically you do is you just check the strip, place it on the steel surface, it should match perfectly that means, the texure of the shot blasted surface and the texture of that text strip should be identical - almost you all be able to say where it is lying then it has been done perfectly. So that is another aspect here that the quality assurance that means at every stage of production, if I take this as a production station.

On the left side, I have my raw material input on the right side is the finished, material output as far as this is concerned, here I have the finish material that is shot blasted clean plate. Here, I have the raw material that is the plate with the mill scale, once it undergoes this operation. I need here to check whether the finish product as far the this station is concern that is a finish product, whether it is conforming to the required quality or not. The required quality is to check for its surface smoothness, to check for its full removal of the mill scale full; both these things are checked by taking a close look at the texture of the surface, so this is done.

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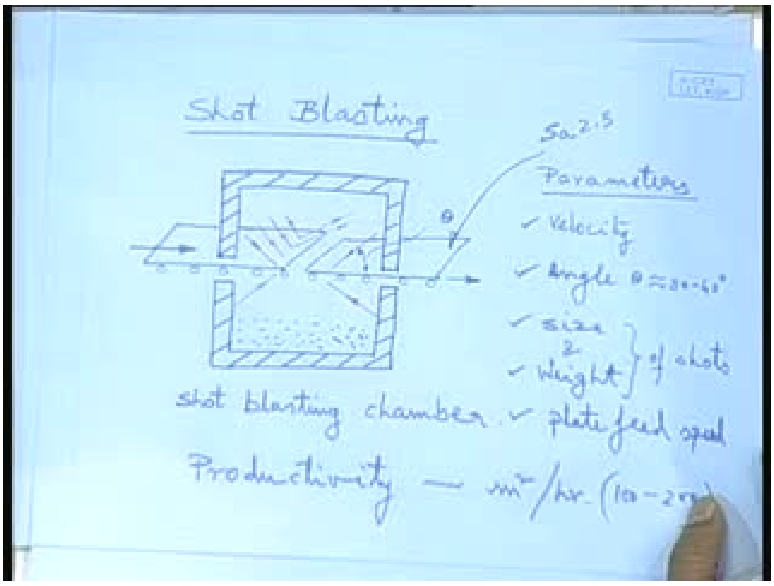

Now, if I keep the plate like this for some time what will happen? It will turn brown why brown? It will be basically oxidised - the surface will oxidised. As you know the plate as it is coming out when will get a final coat of paint to protect it from corrosion and all that, it may not only several months, it can be few years, because the entire ship building process it takes several months; the several months could be 10 months, 20 months, 30 months in that scale. One of the means and these plates will be eventually subjected to a very highly corossive environment eventually, why? Because it will be either operating it will be generally operating in a sea environment - in ocean environment - and ocean environment is a highly corrossive one.

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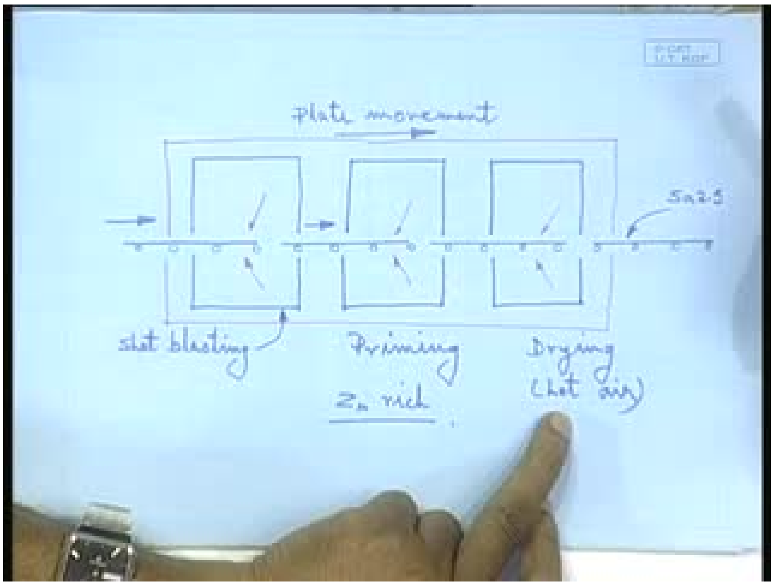

So, to protect it from that corrosive environment there are different schemes, one of the scheme is painting it with some kind of anti corrosive paint etcetera, but that will be done when the product is complete. Means, when you complete the hall before delivery you give the final coat of paint, but till that time what happens you have to also protect it because, otherwise it will lie in the open atmosphere, whatever expose to the atmosphere will corrode.

What is done is, infact once it comes out it immediately enters a shot blast a priming chamber. The plates is coming from the rolling machine entering the shot blasting chamber, we are checking here it is fine and it is just closed by - physically closed by - that means, infact what happens is many times it is under one housing. This entire setup can be under one housing even, only thing you have access at this point from out side to check the surface and rest is did not see what is happening.

So, it straight way goes to the priming chamber; priming chamber is again nothing but, in the similar fashion there we had been blasting the plate with shots. Here will be spray with paint with a kind of a paint; the paint is generally use is a zinc rich paint is used for priming purpose. What is the function of this paint? What shouid be the characterstics? Primary characterstics is that it should be able to protect the plate atleast for several months before it gets its final coat of paint. That means, the paint should remain on the surface should not get washed out, should not gets crashed off or whatever. That means, it should be able to protect the plate for that minimum required period and that minimum required period could be several months that is a number one.

Number two, since after these opertion the plate will be subjected to all kind of bending, cutting, welding opertaions. So, this paint should not come in way of those operations. That means, it should not adversely effect cutting of opertion, neither it should adversely effect welding opertaion, because cutting opertion will be either oxidized flame cutting or it can be plasma cutting or it can be laser cutting. So, none of these methods this plane should interfer negetively.

Next is welding, welding also that it should not interfere that means, it should not cause contamination to the weld deposit. Like, if I use a wrong kind of paint; the priming paint my world will become porous there will be lot of porosity in the world why? Wrong kind of pen means a kind of a syntectic enamel paint I use. It will do all the purpose of producting and every thing but, will burn under heat of welding generate enough fumes which may get trapped and forms porosity in the weld that means, it will produce a defective weld. So, it should not be adversely effecting the element, that is a next requirement. The final requirement is that it should form a good best material for subsequent coat of paints, because this will remain over which you will do the painting.

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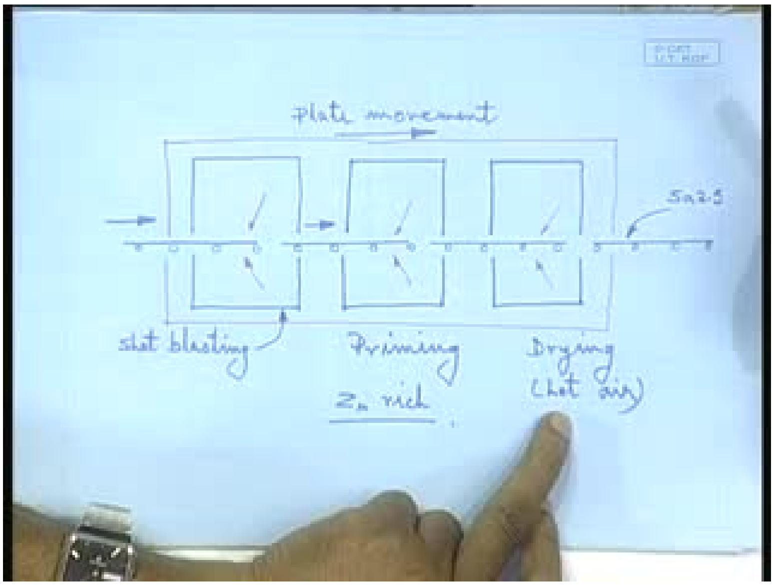

We are not going to remove it, over this only; you may at times do some kind of sand blasting; they do just to clean the surface. The purpose is not to fully remove this zinc rich pen no, because this is a good coating, why zinc rich? Because zinc here acts as sacrificial anode; it acts as sacrifcial anode that means, if any corrosion takesplace the paint will corrode, the zinc particulars will corrode within the paint emulsion and the steel will be protected. So that is what is the priming operation followed by that is drying.

There is a another chamber here nothing but, nozzles blasting hot air drying chamber why? Because after the priming the paint is still wet, see you cannot take it out, your paint will get spoiled. Though this priming pen should be of such quality that it dries up fast but, still it takes some time to enhance that drying process is subjected to a drying chamber where you expose the plate to hot air blast and your plate is dry and so you see the entire plate preparation in this method of shot blasting it just enters at one end comes out from the other end finish plate that means here, you have the raw plate with the mill scale here you have the finish plate with properly prime surface ready for next operations.

So, that is how we see it is quite effective and possibly quite an efficient method of mill scale removal. We stop here today, next will see chemical dressing.