Principles of Metal Forming Technology

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Lecture - 26
Introduction and Classification of Forging Processes

Welcome to the lecture on Introduction and Classification of Forging Processes. So, in this lecture we are going to now discuss about the type of forging processes and there classification and their introduction. So, among them we are going to start discussing about the process of forging.

So, first of all what is forging that we must know. So, forging is working of metal into a useful shape by hammering or pressing. So, what happens that many a times you require to get the different shape of the objects and for that normally you have the dice in the die you. So, in between the die the component is placed and then it is basically compressed with the in between the dice.

Now, that is what the forming processes are in the case of rolling; you have 2 rolls and in between the material will be compressed. Similarly in the case of forging you have 2 dice and in between the material is to be you know pressed. And in that there may be grove inside the die; so the thing is that whatever is the grove inside the die, when the material is pressed the metal will flow depending upon how where it has to flow where it is getting the way; so that it flows.

So, that way that is the processes of forging and during that process you know whatever happens in the case of forming methods like you have the development of average structure, you have the disappearance of any kind of you know discontinuities or defects in the stock like you have the blow holes or shrinkage cavities, they are disappeared. You have the development of average structure also when you we do that process in sequence in a proper manner.

So, that way this forging method is you know carried out and most of the auto mobile components they are made by this process. So, in this case basically you are applying the force from the top or you are applying may be on the side way is also you apply. So, that it will go and it will compensate or it you may also draw it you make an increase its

length you can decrease its length. So, it happens in that process that is the process of forging.

Now, let us discuss about the how we can classify these forging methods. So, as usual when we try to classify these different types of manufacturing processes then first of all we try to classified based on the temperature.

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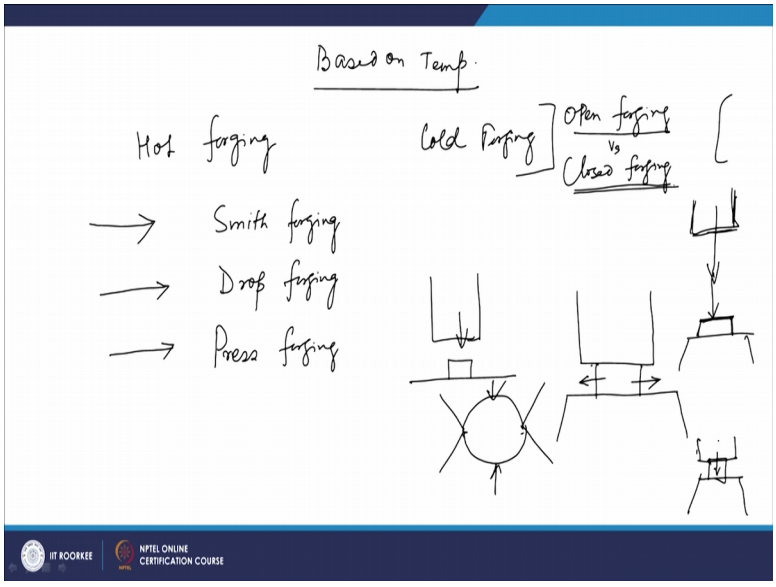

So, if we try to classify based on temperature then you have hot forging and cold forging.

So, as usual when we are going to talking about hot forging, when the stock is heated to a higher temperature higher than its recrystallization and temperature; then we call this process as hot forging temperature, hot forging process. And if you do it below that temperature then we call it as the cold forging you know processes. So, when you have the larger degree of deformation required. In that case you will go for the hot forging processes, because at higher temperatures you can go for higher degree of reduction because of flow stress requirement which is smaller.

And as the temperature will come down then the flow stress requirement will be larger and larger you require larger stress to deformed material plastically. So that will be in the difference between the hot forging and cold forging; hot forging will be done at higher temperature, higher than the recrystallization temperature. Then cold forging will be

done at the lower temperature that is your lower than the recrystallization an temperature like that. Then so that is why you can have the metals hot forged or the cold forged.

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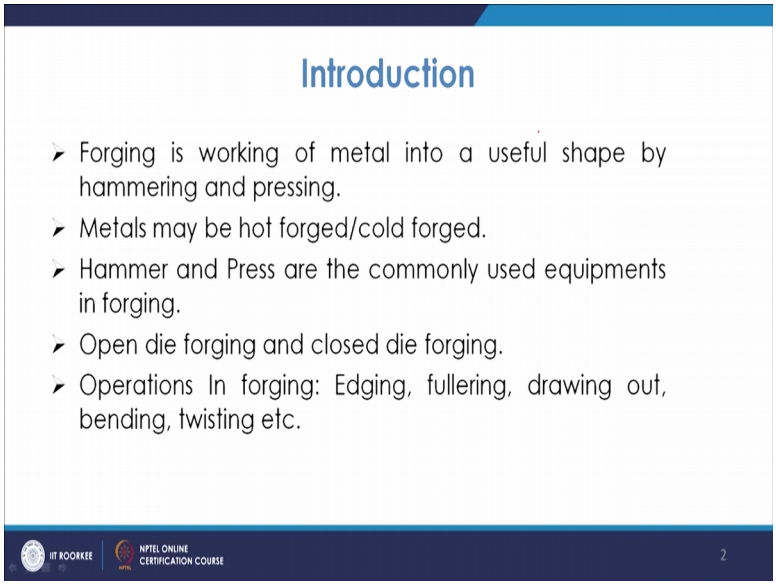

Similarly, you can you if you talk about the different types of a forging operations what are the different you know what are the things which occur in the case of a forging processes or when we try to classify then in that case we also classify based on what way the forging process is carried out.

So, in that we have we have to come across certain terms like you have smith forging. So, is smith forging is something a type of open forging; so, before that let us talk about a forging process known as open forging versus closed forging. Open die forging versus close die forging we may see here that is open die forging and the close die forging. So, open die forging means again when we are; so in normal case forging as we have discussed that if you have a die and then so you have this is your anvil; so, what we do is if you have an object then you tried to forge.

So, the moment will be in the directions; so if we say a flat die at this place and if you are try to forge it then in that case you have the moment of the metal in these lateral directions and wherever it does not have constraint the metal will move. So, and depending upon if you have the you know cavities or if you have the groves made in these places then metal will flow into it; so that way.

Now open die forging and close die forging; now open die forging means now when you have this is example of a open die forging. So, you have these anvil and you have kept the metal and then you are you know allowing it to follow over it and then both are open there is no constraint from any side. So, normally that is known as open die forging and in that normally we you try to get to the simple sips, you when you have to increase it is you know lengthy or width on the cost of its thickness or so.

In those cases all you have to get the simple sips you have to you know make the you know specimen flat or so; so those are the examples of open dice. So, dice are open basically you do not have any groves made in the die and it will be falling upon that. And then close die forging; in the close die forging the dice are closed basically when the die is finally, the both the die have to you know meet each other and they have to be closed.

So, ultimately they the dice have to you know like you know you may have die of only of this type and another may be of this type. So, both the dice; so this way you can come and ultimately if you have the; so ultimately you can have a you know this type of shape made in a close dice. So, ultimately initially they will not close because this process will be in a sequential manner and radiation will also be in succession and ultimately at the end the dice will be closed and the cavity which is their inside the die when the 2 dice are attached to each other, that will be the final shape of the material that you are going to you know get in the case of closed die forging.

Now coming to the different types of forging processes; so, again that is also a classification. So, based on what kind of dice are there; then depending upon type of processes how it is done. So, smith forging it is a type of open die forging and it is the name given based on the Smither's of blacksmiths in the village work.

So, normally you have an anvil and then you heat the material and you keep there and then you are hammering it. So, you are basically making the flat products or you are making the pointed once or. So, you may doing some increasing in the length or you are sometimes making it flat or so, that is normally known as the smith forging.

Similarly you have you know drop forging and drop forging means you are dropping certain weight you know you have a die which as certain weight or the weight may be its own weight or you have the extra weight. Because of the velocity or acceleration with which is it is moving so, and then it is dropping from certain distance.

So, you have a die here and you have a specimen here and something is there it is dropping through this distance; so that is known as drop forging. So, in this case basically you have this is the. So, normally you have use of hammers in these cases; so, basically it will come from certain height and its kinetic energy will be a stored into it will come certain velocity.

And then it will be impacting on this job and this way it will try to deform it. So, that is the example of drop forging and normally we use the hammers in these cases. Now hammers also hammers are the one which use basically make the impact on. So, they basically have the impact type of force being applied on the specimen and then they try to deform the material.

So, so this is the type of forging process where we used this is hammers and that is drop forging. Then next will be you know the press forging; so, the press forging again you have here you have use of press. So, what we do is in hammer as we discussed that you have the material and with it is you know it is the specimen is subject to the impact force; from the hammer which is coming from the top and certain velocity, it is falling you know. And then that basically deforms the material where as in the case of this press forging what we do is that you do not apply the impact force rather; it is squeezed continuously.

So, in the case of press forging when you have the die then it will be in touch with these you know press and then it will slowly it will you know do the pressing or do the squeezing. So, in the continuous manner it will be pressing the material; so, that way that that is known as press forging.

So, here we use the press to do you know the forging processes. So, Smith forging any way is something you know normally for very you know in a general term which we which because of the Smither's we black smiths; we give this name otherwise you have drop forging and press forging are the main 2 apart from that you have also machine forging.

So, that is also there; so in that the material which be only upset to get the desired shape; so that is what is your the machine forging. Now coming to the open die forging as well as close die forging we have seen; that in the case of open die forging anyway the die is surfaces flat. So, it is you know free to you know expand in different directions.

And the material deforms over a flat surface, but when we talk about you know the close die forging. In the case of close die forging, what happens that you have certain shape in mind where the aim is that you have to get the whole you know final shape of that particular type.

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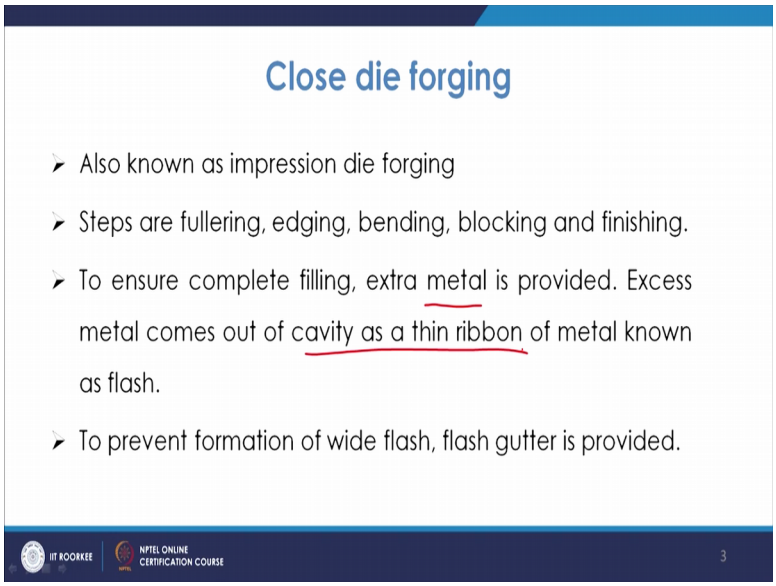

So, so that close die forging that is also known as the impression die forging because what happens in this case that you are ultimately trying to get the impression which is there into the dice. So, ultimate objective is to basically get that you know final shape of the material.

So, the in the case of this impression die forging; you have the steps like fullering, edging, bending, blocking and finishing. So, what happens that when we talk about the different methods; so as we can see that what is. So, first of all you will have the stock which is to be put into a final shape. So, they have to go in succession, you cannot think of you know converting the raw material which is there in the case of (Refer Time: 15:17) or a slab or a stock or a rod. So, you it cannot be converted into the final shape.

So, what it actually do is that first of all you will have the fullering and in the case of fullering; normally what we do is you try to accumulate the metals wherever it is required. So, that is your fullering; so, what happens that suppose when we talk about. So, what we will do you have fullering dice.

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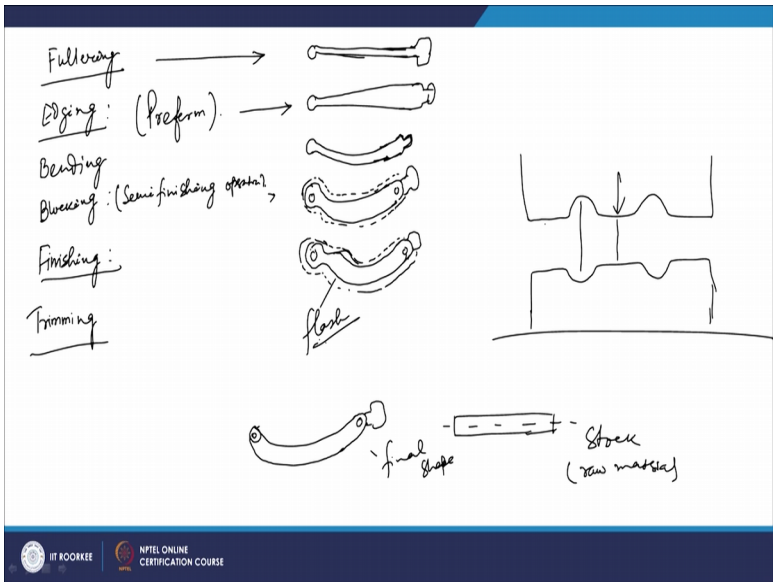

And suppose you have such kind of; so you have such kind of dice and in this case if suppose you are pressing these dice from the side. So, then what will happen the wherever it will get. So, suppose you have to make some component which is thicker here a thicker in these zone so and then you have thinner in these zones.

So, you will have those dice will which will try to oppose the material accordingly more materials in to this side and lesser one here. So, that way we try to you know you know even out the material. I mean depending upon where how much material has to be there in the that cross section; so, that way this process is known as fullering.

So, normally what way is done that one we talk about the fullering. So, in that case you know you have to reduce this stock to the desired size and in that you have to see that the this is basically; it is not upsetting basically, but it will be the reduction in the cross section at these different places; so that process is known as the fullering. Then the next is; so you have first is fullering, then you have the edging and edging is nothing but it is also name is the making the preformed.

So, what we do is in the case of edging we try to gather the you know suitable amount or exact amount at different cross section and also you know it is something like knowing the performs. So, it will the material the shape will be somewhat coming similar to what you have to achieve. So, you will have; so it will basically ensured that you have the

defect free flow of material and you will have the complete die feel and minimum of the loss.

So, edging is nothing but you know it is all also something synonymous with making the perform of the material. And in this ensures the exact amount of material which is to be accumulated at the respective positions. Then if you required you can go for the bending operations like if you see the there are you know the material has the bend shape, then you have to go on the bending dice then you do the bending operations.

So, you have bending then after that you go for blocking. Now why bending is required because many a times if you can get that type of shape even by you know cutting the material and or machining the material and get that shape. But with that basically you have more chances of you know loss of the fibrous structure. So, that is why we go for the bending processes.

And then after that bending you have you blocking. So, basically it is also called this semi finishing operations. So,; so you have the impression which is created which is semi finished. And because you know when we talk about the forging components; now you have the pockets you have basically when we talk about the intricate should components, you have many a places it has to go over the bent there are radios and curvature along which the material as to go and fill, you may have the deep pockets the sharp corners. So, you know you must have actually the blocking impressions.

So, those impressions are basically used so that you ensure that you know the material has to flow accurately I mean at those corner so or wherever the radio is there. So, basically you provide the larger radii and corner and fillets so that the material flows smoothly and there is no any kind of discontinuity at those places. So, in when we talk about the semi finishing impression that is blocking; in those cases you provide these larger radii and also you provide the fillets. So, that you ensure that material goes over that portion and completely fills the cavity.

But still we are not considering about the flash, we are concerned with the easy you know passage of the material or easy moment of the material on the on those corners and fillet positions. And so that the material moves uniformly without any kind of lap or any kind of defect structure in those cases; then after blocking you have the finishing

operation. Now when we are finish the blocking then we are concerned with the larger you know flit corner radii and so, but we are not concerned about the flash.

So in fact, when we talk about the final impression this is finishing is nothing but getting the final impression of the material which is going inside. So, ultimately it will be dealt I mean it will be dealing with the final shape of the material and basically that is ensured when you also you know come to a conclusion or that is characterized by some event like you are assured that you know; there are you have some extra material which have which was there you know in the stock and that extra material basically has come out.

So if you think about any casting process also in that if there is a (Refer Time: 23:12) which attached in a side. And if the metal goes into the casting and then through that is goes into you know the raiser then filling of the raiser will ensure that the casting is already filled. So, similarly in this case what we see is you have you basically supply some extra material and that extra material will form as the flash and that will be seen.

So, then once this finishing processes is over it means your material is ready with some extra material and that extra material is known as flash. Now the next process which is there in the case of this close die forging is trimming. So, in the case of casting we call it as fuddling, where we remove all these you know extra attachments to the cast product.

So, by cutting or by flame cutting or by machining you could you remove them like gates or raisers or so; in this case you have the formation of the flash and this flash needs to be removed and that is known as the trimming process. So, this is basically the component of this there are the different stage is in case of these you know close die forging so that is what it happens.

So, if you try to look at you know the different stage is in the case of the component which is made. Suppose if the component is made of made like that of a lever; suppose you which is used in the you know automobile. So, suppose the lever has the actual shape.

So, suppose you have this is the actual you know shape of the lever. Suppose that beings the one which is you know a lever is to be made and this is your final shape of that lever. Now the thing is you have a stock which is normally of you know any shape which is very plane shape or so, now, you have to convert these into a lever.

Now, for that first you know you will have a stocks; so, the stock is in this shape. So, this stock is there; so this is the stock it is raw material and this is your final shape. Now how to get it in this? So, this stock material will have to be passed, will have to pass under these 3 the successive you know stage is and finally, it will come to this shape.

So, first is you know fullering and as you know that you have in this side this is the size of which is here and this side you have here. So, this is somewhat smaller; so, first of all you what will do is you will make a component like this; you will make in the fullering die. So, so this way you get. So, so this way when you are trying to give under such die and it will you know increase its it will you know draw out it and there it will come to its this shape that is known as fullering then coming to the edging.

So, for edging what is done now is now; now you will further you know bring and gather the metal to different regions and then you have this. So, so this way; so this way you are going to get, so that will be your edging. So, the here basically the amount which is required in those you know regions that will be accumulated. Then if you required the bending; so for that what you do is you put it under the bending dice and then it will be basically bent.

So, so it will be it will be bending like this and then so you have put under the die and then it has bent. So, that is your use of the bending dice to shape the component in the by bending it; then you have blocking and in the blocking what happens is that now you will put under the this is semi finishing operations that way. Now it is all on the bend specimen and then you will have the formation of these. So, but here you try to ensure that the material which is there which is flowing in the some extra material.

But any way here we are not concerned with defining that and when we go to the finishing; at that time again you have in that. So, here you ensured that the material has felt as filled all the regions. So, that will be further the finishing stage and then so it will go like this and then you have this structure made and you have the extra regions which is the trims. So, here you ensure that this extra material which there the parting plane that is done and then ultimately you are removing this extra flash and that removal is known as trimming.

So, these are the different stage is in the case of the close die forging. So, this is about the you know impression die forging what we have discussed and there are certain you know

considerations which are required to be seen, you provide these you know extra metal so, that there is complete filling of the cavity. Excess metal will come out of the cavity as thin even of metal known as flash and then to prevent the formation of wide flash; flash gutter is provided. So, that is because you know if the you know if the too wide then so that way it because that temperature goes less and then the distance will be there. So, it will require larger and larger force to further press it down wards. So, that is why this gutter is provided in such cases.

So, these are the considerations when we talk about the close die forging.

Thank you very much.