Welding Processes
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Variants in resistance welding Part 02

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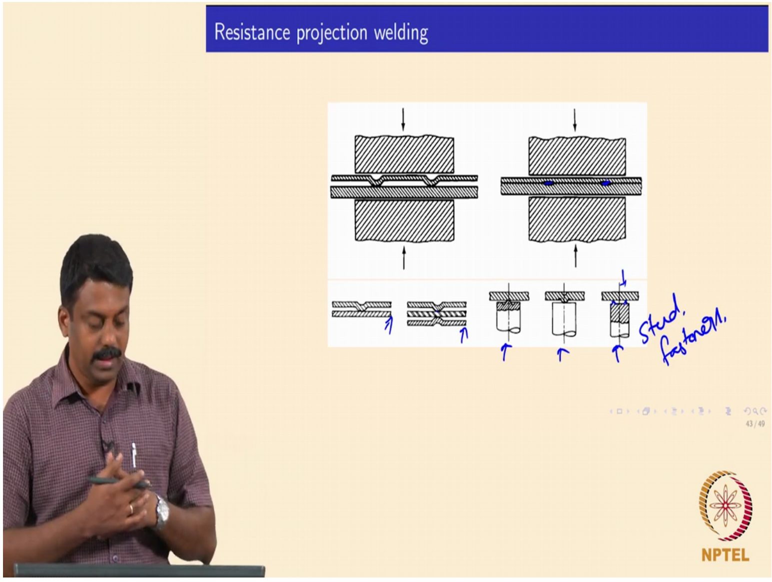

The other variant in resistance welding is resistance projection welding. Okay, so resistance projection welding, so what we do is instead of making like for example a 2 flat surfaces, you will always have a problem of dissimilar thickness of welding, is not it. Suppose if you have a flat joint, flat plate and then a bigger higher thickness flat plate welded using resistance spot welding, you will always have a problem, okay. So, instead of keeping 2 flat plate, you will also have sort of rejections in within the sheets, okay.

And because of that the heat is concentrated, is not it. And you may not, you do not need higher current, to heat up the entire interface, right. And if you are doing spot welding, individual spots, for example here you need to have one electrode and other electrode here. So you may allow to do it, for example 1st weld here and then go back with the machine at this point and you have to make another joint.

So, instead of doing that, you can make some projections and have a larger electrode with a similar current density what you are doing it in the previous resistance spot weld, you can do welding at multiple points, is not it. The contact resistance, the contact area remains the same as the resistance spot weld. Okay, so instead of doing it in a sequential manner, the 1st you do resistance spot weld here and then move it over the other place and do it again here and so on so forth. So you can use a slightly larger electrode by having a projection in one of the sheets.

So you can make heating here and here and subsequently you can do a compressive loading at the interface and the sheet becomes slight up. And the advantage over here is there is mechanical deformation which can also aid the weld interface formation. Right. So, the projection buildings can also be used effectively, especially when you are doing, when welding similar thickness is. And this is done in various geometries, whatever things, for example single sheets, you can also do multi sheets to make laminates, okay.

So, in this case you may also have 3 sheets welded together and you also have some projections and these are commonly used for welding studs or the fasteners. So, these are various fasteners and they will have to be attached through a solid bed for example, right. And you can pass the current and then you will have a contact area leading to contact resistance and subsequently you can push, make joint. Right. And the resistance projection welding with slight modification in the discharge mechanism, okay, so you can also make what is called as the capacitor discharge welding. Okay.

Which is very commonly used to weld the studs or the fasteners and thermocouples to any substrate, okay. So, that we will see in the last slide, right. So this is clear, resistance projection welding? So we will have a projection, okay and then we apply current and then press it, we can make a joint. So, compared to resistance spot welding, this is advantageous because you can do multiple be good. Welds at a single step, all right.

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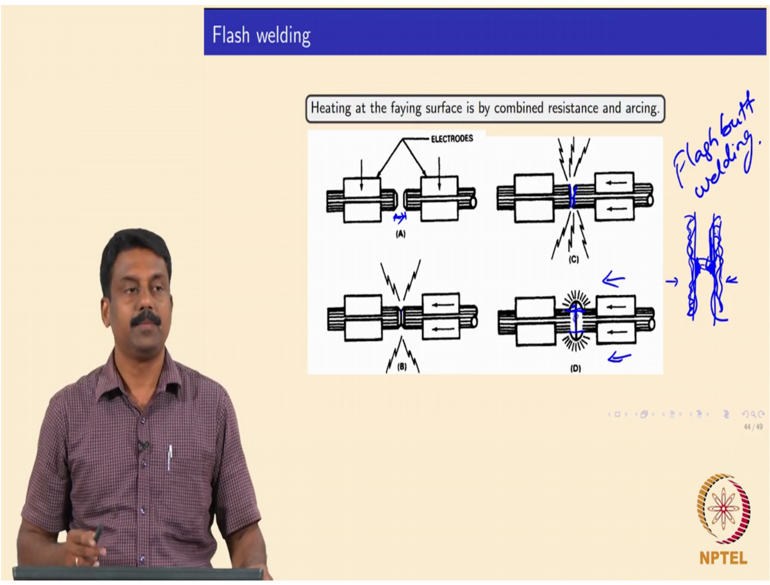

Okay, so the other variant in the resistance spot welding is flash butt welding. Okay, and one of the other major variants of resistance welding, after resistance spot welding. Okay. So this is known as flash butt welding. The most common application of this welding process is wheel making, okay. So, wheel means, the steel alloy wheels that are used for the vehicles, automotives. Okay, so those wheels are all made with resistance flash butt welding. Okay.

So the wheel making process is always done, you have a flat sheet, it is rolled, okay, and got into contact to each other and then in the flash butt welding, the mechanism works in such a way that we do not really keep both sheets together in contact, we maintain some gap. Okay, that is what is shown over here. So, we keep some gap between the interfaces, right. And then you pass the current forces so, when you maintain a gap, obviously when you are passing high-frequency current, you will start arcing, is not it.

So, arcing would lead to the melting of the interface, right. The 1st melting would take place, for example this is my surface roughness, okay and when you pass a current, so, obviously this point would start melting 1st, is not it. So it will start from arcing and then once it melts, it will explode, okay, and then becomes slightly flatter for example. And similarly next spline would come and then this will melt and subsequently it will explode and remaining parts for example, next part will melt and ultimately we would make a more or less a uniform interface, is not it.

And this process, because these are all molten you will end up heating these adjoining areas high temperatures, is not it. So, you are melting the interface, so obviously the regions next to the molten layer would be at very high temperature. That means that now those regions can drastically flow, mechanically deformed much easily. Okay. So, you strike an arc, you melt interface and then once you reach the temperature which is sufficient to achieve the mechanical deformation and then do and upsetting, okay. Right.

So you have one arcing and melting the interface and subsequently you apply a load and so that and you have now upsetting and in this process the water layer at the interface will be sent out, is not it, as a flash. So, whatever layer is molten will be sent out as a flash and then un-molten region would coalesce and form the interface. There are a lot of advantages of this process, okay. The advantage one is surface reparations. You do not need to prepare the surface, is not it.

So you will have to bring it together, even if surface is rough, you have a lot of oxides, does not matter, right. So surface roughness can be overcome, the moment you start arcing, you will end up melting the surface and you will make a uniform liquid layer at the interface. So, once you make it, you upset it, so whatever liquid is there, it will be sent out as a flash. Even when liquid is oxidised it does not matter. So, all the oxides which are there in the liquid also will be pushed out and subsequently the regions which are not molten, okay, the un-molten region would mechanically deformed and coalesce to make our joint.

And this is an extremely user-friendly process. Okay, and very robust process. Because the arc heats up, melt the interface but liquid would not form in the joint, so we upset it, so that the liquid is flashed out at the circumference and then the mechanical deformation would lead to the coalesce the interface forming a weld joint. Yes, clear. And this process is very commonly used to make wheel rims. Right, so almost 95-99 percent of conventional wheels are made with flash butt welding. And there is another variant of resistance welding, which is similar to flash butt welding, which is known as resistance upset welding. Okay.

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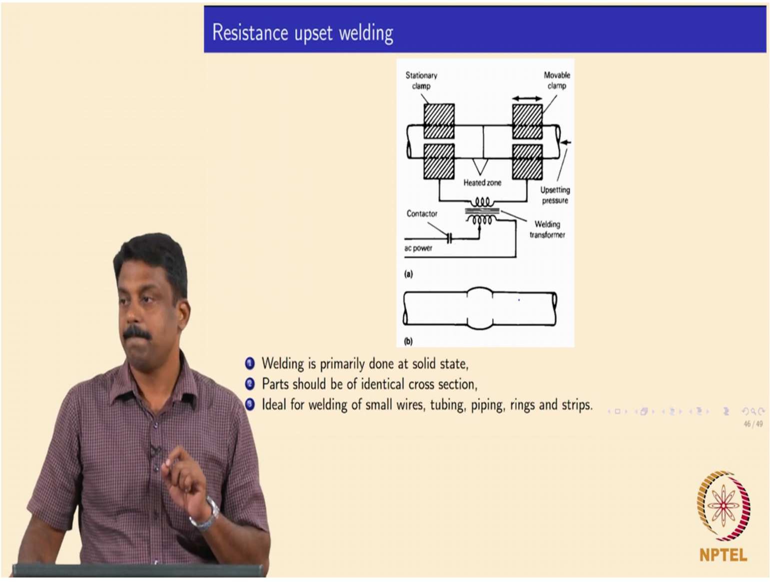

And the difference between resistance upset welding and flash butt welding is in resistance upset welding we do not arc, we do not melt the interface, okay. In flash butt welding, it is important to understand the difference, in flash butt welding, the interfaces, they are not kept close to each other there is always some gap maintained in the beginning so that we can form an arc, okay. So, arcing is important, the interface will be molten, okay and then to do an upsetting. Whereas in resistance upset welding, we keep the interfaces as close as possible, okay and then we hit it up and in resistance of that building we do not melt anything, right.

So we do not melt anything, we just heat it up, the moment the temperature is reached to a higher level, then we do and upsetting to form a joint. So, welding is then in a solid-state, there is no liquid involved in resistance upset welding. And contrary in flash butt welding, we always have a liquid and the interface. Right, it is clear. So, in resistance upset welding, the building is primarily done in solid-state. So, because of that the interface would be prepared very well, is not it.

So otherwise if you have an oxide, if you have some contaminants, grease, then they would be trapped inside the weld, right, it is clear. So, resistance upset welding is also very commonly used for wireless, pipes and tubes, where you keep the interfaces together and then you do and upsetting force and so that you can do mechanical deformation at the interface leading to a joint formation.

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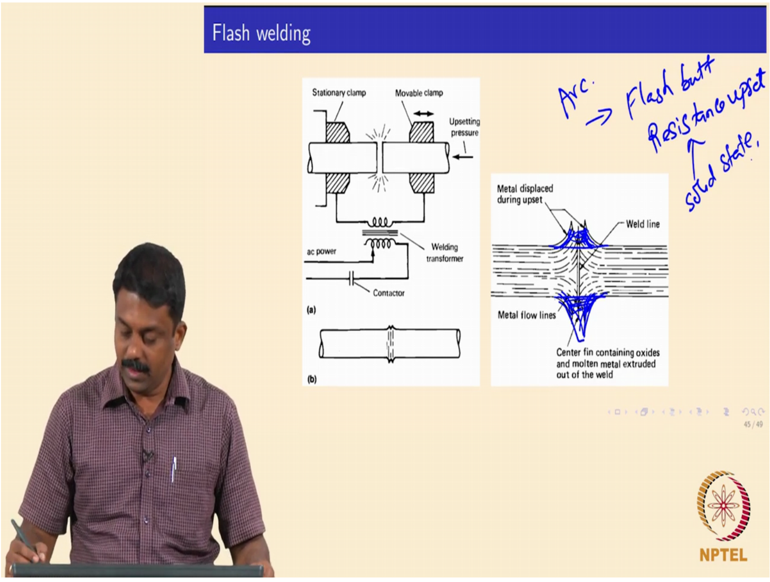

Okay, so in both the processes, if you look at it, so basically the flow of material upon upsetting takes place in such a way that you will have a mechanical deformation and most of the cases the interface contaminant are pushed to the Flash region. Is not it, so it is slightly after deformation. So, the material is deformed and displaced towards the Flash regions. Okay, in flash butt welding it is very effectively done because whatever goes out if liquid. Edited, so liquid carry all the inclusions, all the contaminants which are there even before welding.

And then subsequently if you Machine this off, so you make a very nice joint and then you take the interface contaminants out, you will end up having a nice weld. Yes, it is clear. And resistance upset welding, generally the upsetting distance will take care of the contaminant issue. Right, so if you are upsetting for longer distances, obviously you also increase the

Flash distance. So, whatever is, it was there before welding, we push to outside, right. So basically you are pushing it and if you have the upsetting distance higher, you will end up sending the interface which was there before welding outwards.

So whatever contamination that have happened or it was there, you did not clean properly will be set into Flash and you can Machine it off, subsequently. Yes, it is clear. Any question in these few processes? So, you should always see the difference between flash butt and then resistance upset. Okay, in flash butt there is always arc, Okay and in resistance upset, it is close to solid-state welding. So, in flash butt welding we form an arc, build the interface and subsequently do upsetting, so the molten interface will be sent out as a flash and then subsequent mechanical deformation will lead to joint formation.

In resistance upset welding, the arcing part is out. So, we will have a heating of the interface leading to, decreasing the interface and then subsequently with a desirable and compressive load we can mechanically deformed the interfaces and coalesce from the weld. It is clear, the differences? It is very important. So someone says that you know both are same, so what welding process you are using, then it is upset welding where the arc is there, then it is wrong. So, this classification is different.

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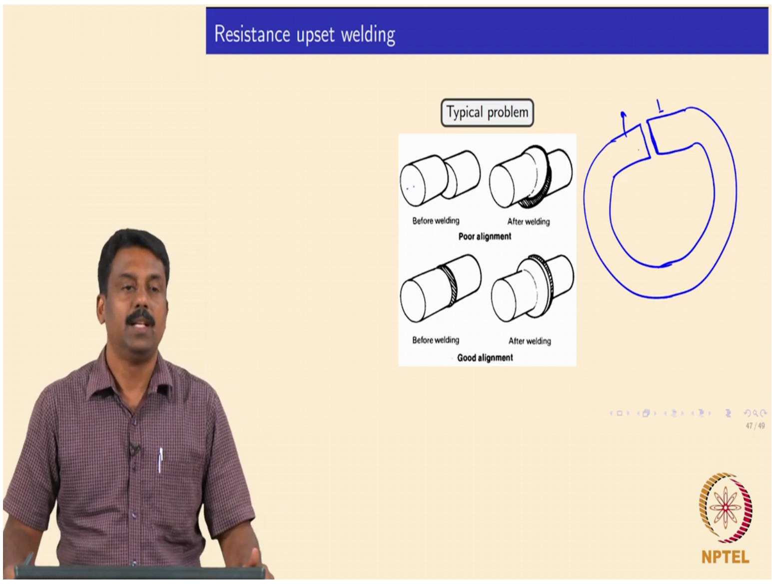

So there are some problems in both the processes, flash butt and resistance upset. The alignment, the geometrical alignment, it should be perfect, it should be coaxial. Suppose you are welding 2 tubes by resistance upset welding, you are not aligning properly, you have serious problem. Right. So say in this case, I am just given a couple of examples. So, if you have the axes of the tube is not aligned properly, so obviously you will end up smearing the pipes, okay.

And this is a very common problem, I will in wheel making, if there is a small misalignment and you have say 2mm or 2.5mm sheets that are commonly used per wheels. So this is one edge of the wheel and the other edge should be perfect. If the other edge is somewhere here because of the most common problem in the rolling of circular pipes is Spring back. Okay, so if your Spring back is not controlled properly. So if I extend that, okay, something like this, a cross-section.

Anyway it is not symmetric, imagine this is a Dicor, so the wheel is likely. So now we face the Spring back, obviously returned will be different. So we are feeding flash butting, the alignment will not be proper. So, then there must be an additional arrangement with our clapping, so the now this can be pushed, this can be brought down so that you will have a perfect interface and then you can make a joint. Right, so this alignment problem is very critical and there are ways to overcome. So they are actually coming from the equipment manufacturers, right. And these problems can be tackled very easily.

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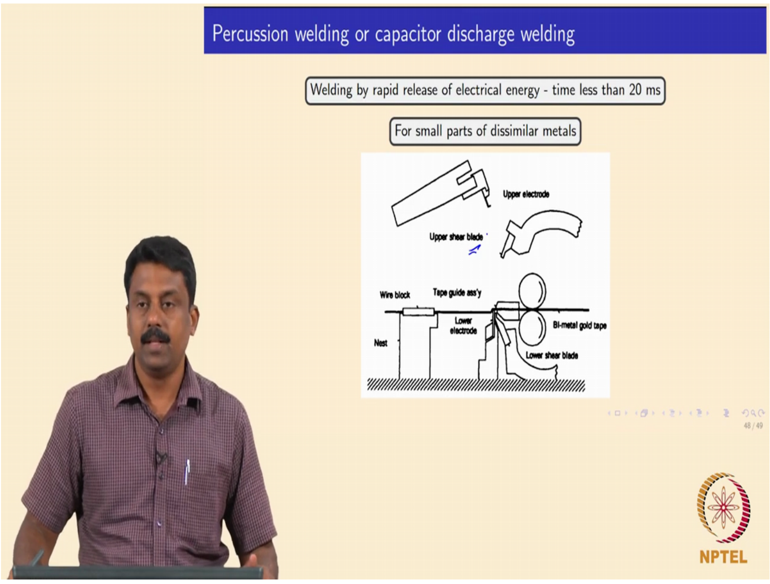

Right, so what else is the lost in these varieties, is actually commonly used for welding fasteners, studs, bolts, okay, into bodies, using a capacitor discharge. Okay, so it is like a gun, okay. So, you will have a capacitor giving a discharge of current in a short time, at a very high frequencies as well as a very high amperage current, set as a short burst, so that it is like in a gun, short stud gun. Okay, so in this process the welding is done by (())(17:25) electrical energy in a very small second, in a very small time.

And then it is extremely rapid process, right, each weld would take hardly a millisecond and then one electrode would be going, for example I show the schematic, the upper electrode, okay, and then there will be sharing blade. So, it will hold, it will share, it will share like that. And we have one equipment in our lab to weld thermocouples. Okay, so thermocouples are thin wires well run a flat sheet, is not it. So, we attach the thermocouple into one electrode, the material to be used will be another electrode, we have positive or negative ions and then you discharge the current and then simultaneously you also apply a compressive load.

Okay, the electrode is dropped on its own weight sometimes onto the sheet and the moment you have a contact, large amount of electrical energy is discharge. Okay. So in that process we end up hitting the edges and also there is a compressive load acting on the surface leading to a weld formation, right. As this process is very commonly used for welding studs and bolts to the body of vehicles.

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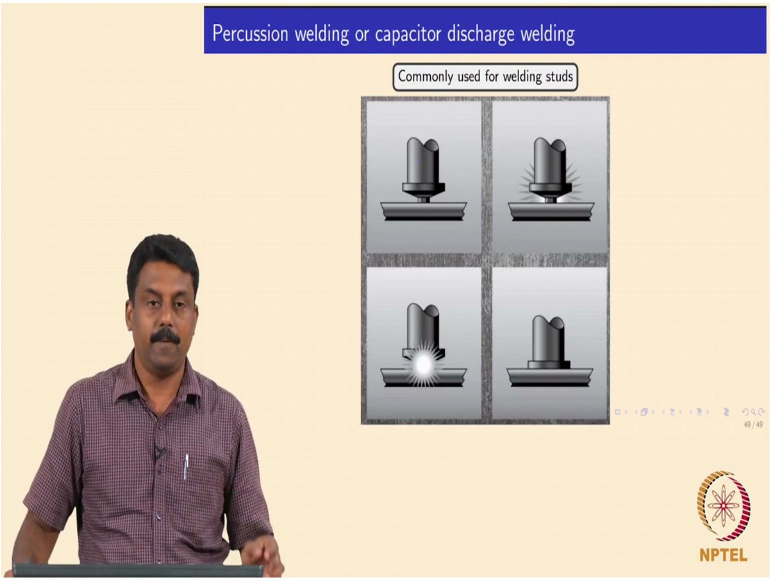

Say for example, I just showed a schematic. And these are done with the gun, okay. So, if you look at automotive industries, it is commonly used in the front below the engine placing. So engines are all, the bodies are placed over the fasteners, right. Those fasteners are welded with the bottom panel. And before mounting the engine if you look at it or if in your vehicle to take out the engine and you see the bottom panel, there will be lots of studs, bolts attached to the bottom panels, right. And those bolts are attached to the panel by the capacitive discharge welding, okay.

So there will be one robot with, like a gun, this can also be done with a gun, handgun as well. So you fill with the bullet, which is now studs or bolts and then you bring it in contact, something like this in this case. And then pass the trigger, you discharge the current at the interface simultaneously you also use an air velocity, airgun or something like that, the studs will be going towards the piece. The moment you have a contact, the electric current is discharged, then you melt the interface and form a solid joint, okay. So this is commonly known as percussion welding or capacitive discharge welding.