Welding Engineering
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Module - 3
Welding Power Source
Lecture - 2
Types of Power Sources and their Characteristics - II

So, in last presentation based on the welding power sources that was the first lecture which was mainly based on that, the different types of the welding power sources and how the welding power sources are different from the domestic power sources? We have also seen that what are the factors on the basis of which we can classify the welding power sources, and where the particular kind of the welding power source can be used? Apart from that, we have also seen some of the characteristics of the power sources, like open circuit voltage and the power factor associated with the welding power sources and the static characteristics.

So, there are three types of the common, there are three types of the static characteristics of the welding power sources. One the constant current type of the power source, constant voltage type of the power sources and the rising characteristic power sources, so we have seen in detail about the constant current type and the constant voltage type of the power sources. We have also seen that the constant current type of the power sources are used for the welding processes, where the fluctuation in arc length can be significant like in the manual metal arc welding process. That is, the sealed metal arc welding process and the gas tungsten arc welding process, which are the manually controlled.

While the constant welding, constant voltage power sources are used in the semi automatic welding processes, where the electrode is fed automatically and the torch is moved either manually or through some mechanized device. So, in these processes, the constant voltage a power source associated in association with the constant feed drive system helps to achieve the self regulating arc. So, in continuing with this these characteristics of the power sources today, we will take of first that how the constant voltage type of the power sources can be effectively used in association, with the constant feed drive system to obtain the self regulating arc?

So, that the arc length can be maintained, we know that the arc length is very important in the welding arc, because it effects the arc voltage and which in turn effects the stability of arc as well as the heat generation. So, in semi automatic consumable arc welding process the maintenance of the arc length becomes a very important factor and therefore, efforts are been to maintain the arc length. So, how a using the constant voltage type of the power sources we can maintain the arc length and what other devices can be used to maintain the arc length that, we will see in detail in this presentation. Apart from that we will also see, that what are the additional devices that we need to use in welding processes? So, that arc can be united easily like high frequency unit.

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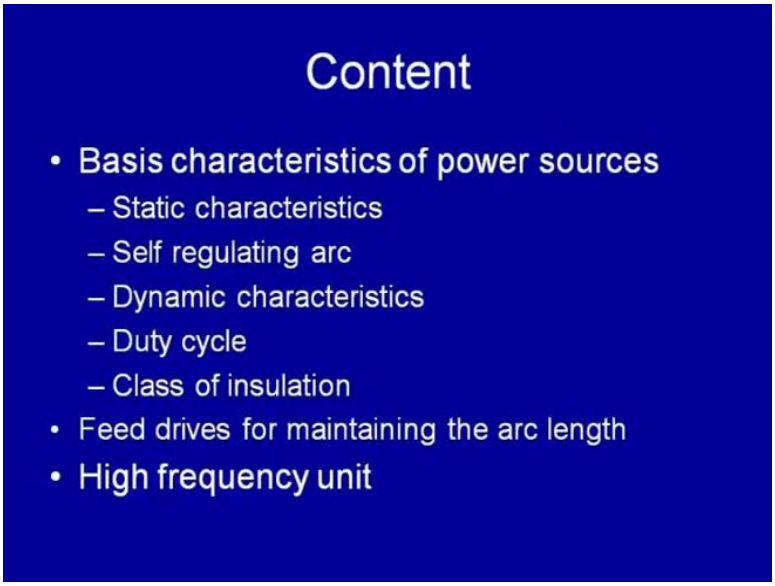

On what basis we select the proper current for continuous welding or for welding when welding is to be done for a certain period of time? So, that is the part with the duty cycle. So, as for as the content of the today's presentation is concerned, we will be going through the some of the static characteristics of the power sources, that is the constant voltage power source in association with the constant feed drive system. So, as to obtain the self regulating arc, what is self regulating arc and how does it help in maintaining the arc length? The dynamic characteristics of the power sources which indicates, that how fast a welding power source response to the changing conditions during the arc welding, especially in respect of variation in the required arc voltage and the requirement of the welding current?

The, duty cycle is another important factor related to the welding power sources, which indicates that how long welding can be done, without interruption over a period of 5 minutes cycle time or 10 minutes cycle time depending upon the kind of a standard which is being followed? It also it is effected by the welding current, which is being used for the welding purpose, for the… We will also be looking into the need of having a particular kind of insulation and how does insulation class effects the duty cycle and the temperature conditions under which it can walk successfully during the welding? We will also seeing the different feed drives, which are used for maintaining the arc length and the high frequency unit.

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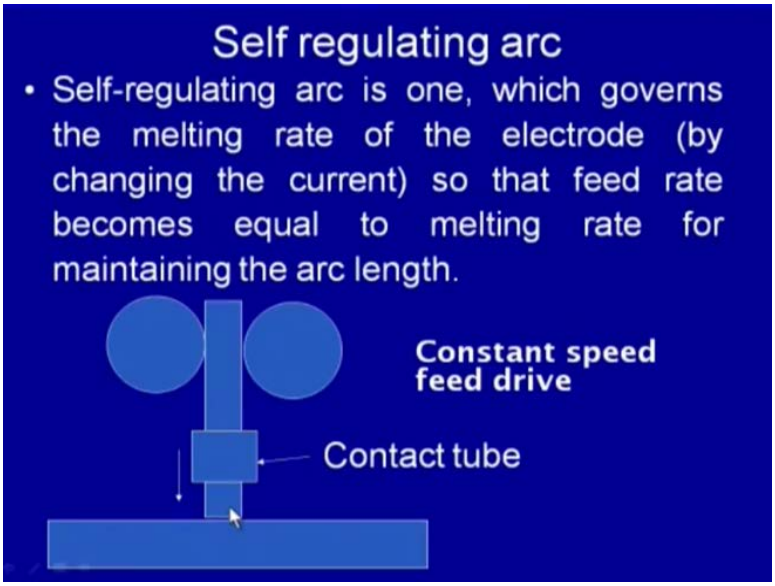

So, going with the self regulating arc which is established when the constant voltage type of the power source is used in association with the constant feed drive system. So, self regulating arc is one which governs the melting rate of the electrode by changing the current, so that the feed rate becomes equal to the melting rate for maintaining the arc length. So, this is one of the important thing that in this process in self regulating arc the melting rate is controlled in such a way, that it is equal to the feed rate, so that when the two are equal the arc length is maintained.

For this purpose electrode is fed using the constant feed drive system and the gap between the two is maintained closely with the help of the self regulating arc. To look into the greater details of the mechanism, through which self regulating arc is

maintained, for that we need to see that if there is any fluctuation in arc length due to any reason. It will change the welding current especially, when we are using the constant voltage type of the power source. So, any change in the arc length will change the welding current which in turn will change the melting rate. The change in melting rate for a constant feed drive system helps in maintaining the arc length.

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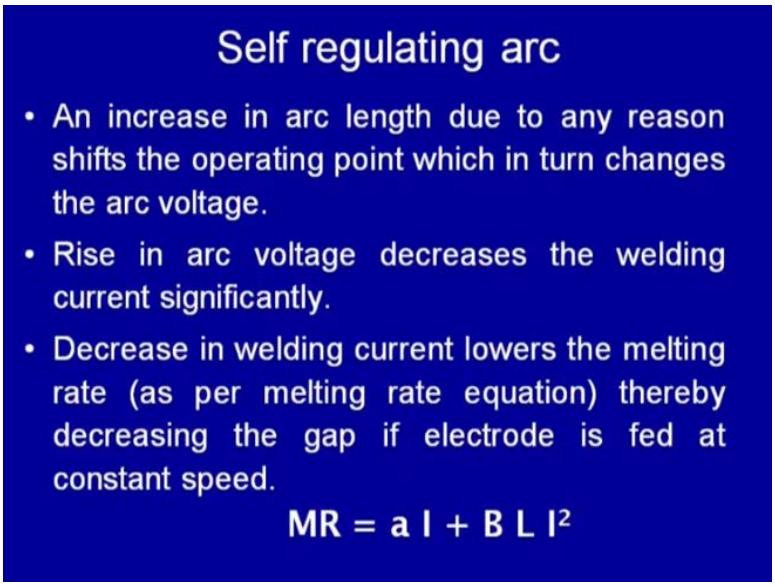

For example, an increase in arc length due to any reason shifts the operating point which in turn changes the arc voltage, so whenever there is arc change in arc length whenever there is a increase in arc length arc voltage increases. With a constant voltage type of the power sources an increase in arc voltage is always associated with the decrease in welding current, and so the reduction in welding current in turn decreases the melting rate. So, for with the decrease in melting rate, the rate at which electrode will be advancing towards the pool will increase. For the constant feed drive system this decrease in a welding current.

We know that towards the melting rate based on this equation, we suggest that melting rate is the function of a I plus B L I square. Especially in case of the high resistivity materials of the small electrodes and those having with the large extension, the melting rate is significantly controlled by the welding current. So, due to any reason, if there is a change in arc gap, arc gap will change the welding current and the change in welding current effects the melting rate, which in turn helps in regulating the arc length as per the

requirement. Especially, when the electrode is fed at constant rate, so here if we see look into this diagram, this is the constant voltage type of the power source the characteristic.

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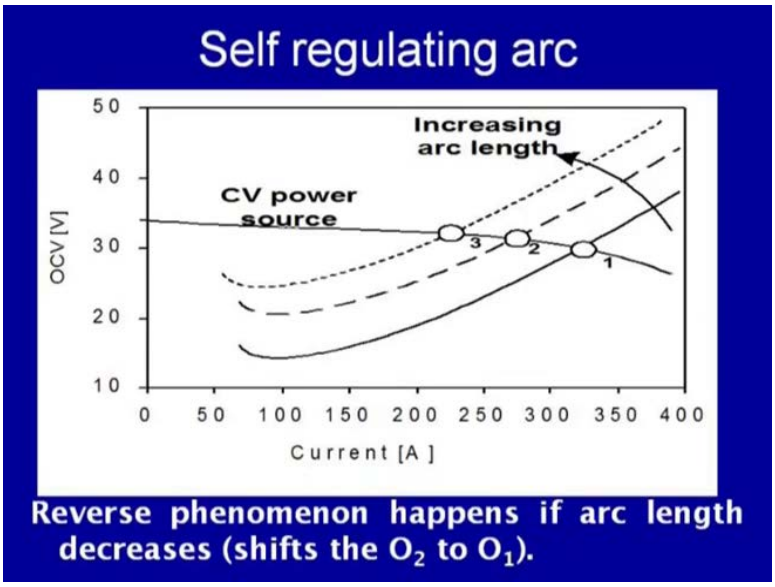

The, constant voltage type of the power source having slightly dropping voltage current line, which indicates that for one arc length the arc characteristic goes like this. It is intersection of the arc characteristic with the power source characteristic gives the operating point. If there is any increase in arc length and shifting in increase in arc length changes the arc characteristic, say from the formula into the solid line and this change in arc characteristic. It is results in the change in the operating point and change in operating point is accompanied by the minor increase in the voltage.

The minor increase in voltage is associated with the significant reduction in welding current say from 330 to the 70 ampere, so this reduction in welding current in turn will be decreasing the melting rate. If the electrode is fed under the conditions when melting rate has been reduced it will help in decreasing the arc length, so the arc gap is maintained. So, whenever there is change in arc length it effects the arc voltage and effects the melting rate, and thereby under the constant feed drive conditions it helps to maintain the arc gap. We can see the reverse example also say, for example there is a decrease in arc length takes place so the decrease in arc length due to any reason will lead to the reduction will lead to the change in arc characteristic.

Say from point operating point three to the operating point two, so this shift in arc change in arc length will shift the operating point due to the change in arc characteristic and this will, this will be accompanied by the decrease in arc voltage. We know that with the constant voltage type of the power sources reduction in arc voltage is associated with the increase of welding current and this increase in welding current is very significant which in turn will help to increase the melting rate. So, for the constant feed drive system where decrease in arc length has taken place an increase in melting rate will result in the increased arc gap and so as to help in maintaining the arc length.

So, that how you see the self regulating arc helps to maintain the arc length. Especially, when the constant voltage type of the power source is used and the constant feed drive system is used. This principle is very frequently used for maintaining the arc length in the gas metal arc welding process and the sub merged arc welding process, were a small diameter electrodes are used. But if the electrode diameters are large, then the melting rate will not be governed by the change in welding current, so fast and this method of maintaining the arc length will not be very useful under those conditions.

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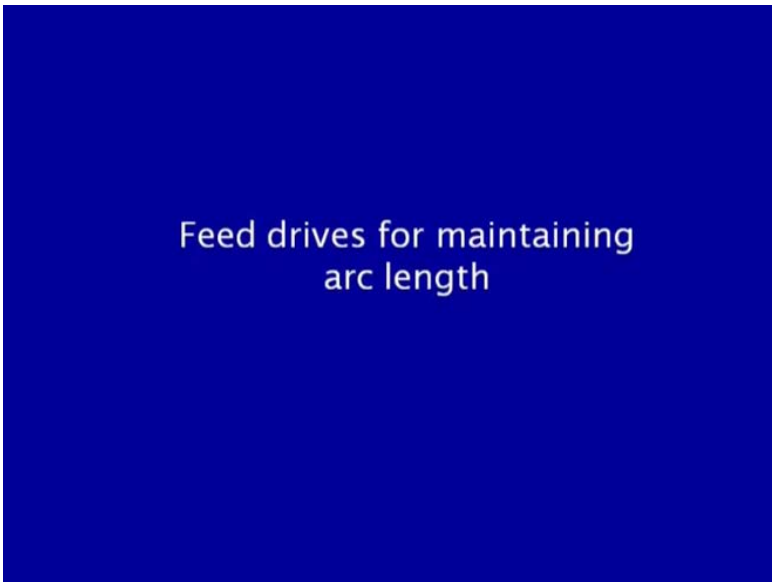

The, different approach is used for maintaining the arc length and that is mainly based on the use of the very able feed drive systems so that we will be talking about that we will be talking slightly later. So, here we see there are two types of the feed drive systems which are used for maintaining the arc length.

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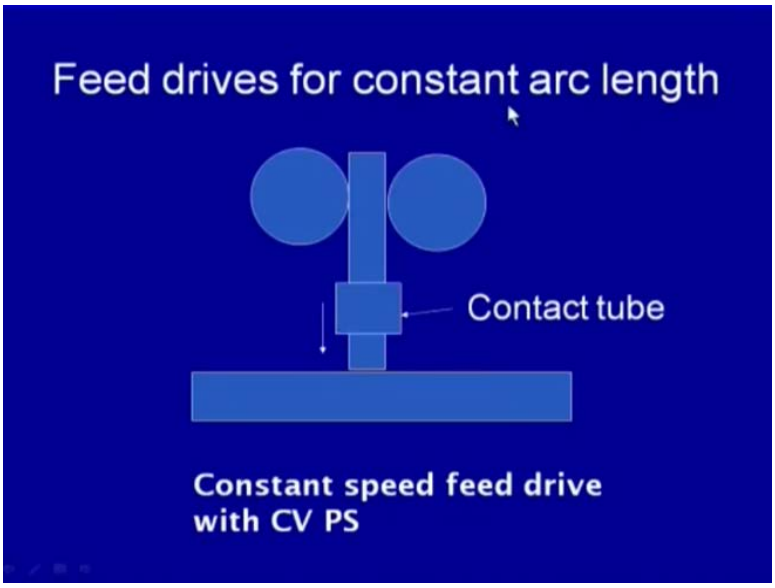

One which is used in association of the constant voltage type of the power source, in these conditions the constant speed feed drive system is used, so that helps to maintain the arc gap. But this approach is mainly used for the welding processes when a small diameter electrode is used with a large extension large electrode extension and the material is reasonably of the higher electric resistivity. So, that the B L I square component of the melting rate is high enough to regulate the melting rate. Under those conditions, this the constant feed drive system in association of the constant voltage type of the power sources helps to maintain the arc length. Another approach is of the variable feed speed drive variable speed feed drive system.

Under these conditions, the constant voltage type of the power source is not used, but this kind of feed drive system is used when the electrode diameter is large enough and the electrical resistivity is also low. So, the variation in current does not affect the melting rate as significantly, as in case of a small diameter and high resistivity materials. In this case the melting rate is primarily governed by the first factor that is a I of the melting rate equation instead of the second factor, where B L I square was dominating in the earlier case. So, under these conditions where the change in welding current is not significantly effecting the melting rate, under these conditions the arc length is maintained by a with the help of the variable speed feed drive systems.

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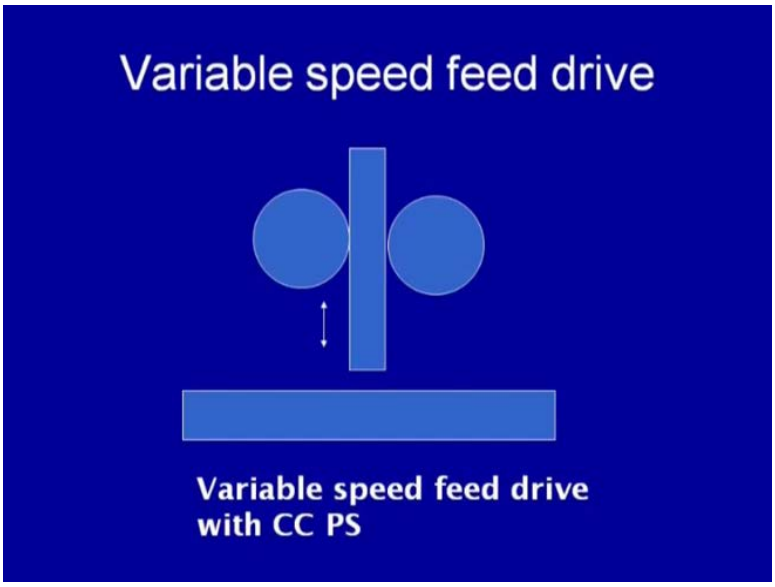

Under these conditions, the constant current is constant current type of the power source is used, so that the heat generation rate is constant and heat generation rate is constant means the melting rate will also be constant. Due to the fluctuation due to any reason, if it takes place then the arc gap will either be increasing, or decreasing so this to take of this fluctuation in arc length causing the change in arc gap. This will be changing the arc voltage. So, this change in arc voltage is used as used as a input data or input for changing the current value being used for driving the motors of this feed rollers. So, if the arc gap is increased this increase in arc gap will be increasing the arc voltage and this in increase in arc voltage is used to, used as input to reduce the current being used.

To current being fed to run this rollers current being fed in the motor drive system, to drive these rollers so that the speed of this rollers can be reduced. Because the roller speed of this rollers will be, will be deciding the speed at which electrode is being fed during the arc welding. So, reduction in the speed of this rollers will reduce the rate at which it is being fed, so or inversely conversely we can also say that if the gap is increased due to any reason, so electrode this speed is increased. So, that gap can be maintained or if the gap has been reduced, then the speed of the rollers is if the gap has been reduced then the speed of the rollers is reduced, so that the gap can be increased.

So, for constancy of the arc gap it is necessary that this gap is maintained by changing the feed rate of the electrode and this change in feed rate of the electrode is obtained by changing the RPM of the roller feed drive system. The change in roller feed drive system

is obtained by changing the current in being fed into the motors, which are being used to rotate this feed drive system. So, this input or arc voltage is used as an input to regulate the current in motor being used to drive these feed rollers, so that the speed of this rollers can be increased or decreased in such a way that the arc gap is maintained.

So, this is the kind of system, which is used for maintaining the arc length by using the variable speed feed drive system. Another type of the characteristic of the power source is the rising characteristic, in this type of the characteristic an increase in welding current increases the arc voltage, this that is why it is termed as the rising characteristic, because it shows an increase in arc voltage with the increase of welding current.

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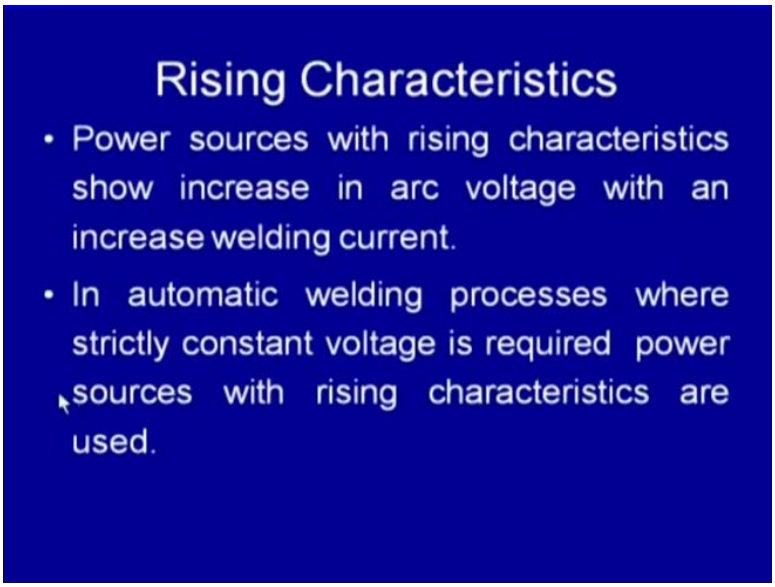

So, in the automatic welding processes where strictly constant voltage type of the constant voltage supply is required, then rising type rising characteristic power sources are used. So, the typical characteristic of the rising characteristic power sources we will see in this plot. It shows in the y axis open circuit voltage and in the x axis welding current. We can see that this straight line is slightly sloping half ward, is the rising characteristic power source characteristic. We can see that if, when we, if we increase the welding current. There is very marginal increase in the arc voltage. This type of the characteristic power source are important for those welding processes, where it is strictly required to have the constant voltage. So, a further we can see that if we change the arc

length there will be there will shift in the welding current. The increase in arc length say decreases the welding current significantly, but the arc voltage remains constant.

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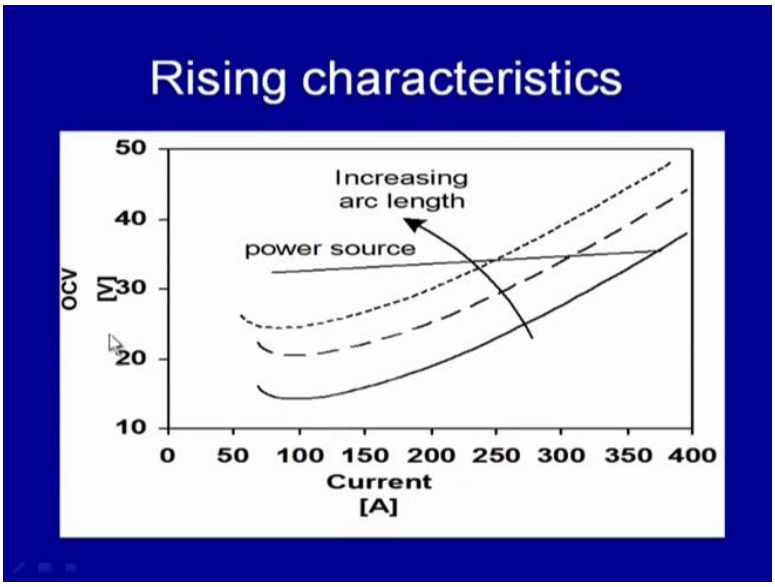

So, with the change of arc length however current decreases, but the voltage largely remains constant. So, this type of the power source characteristic is useful for those automatic welding processes. Where, it is required to have strictly constant voltage, so that the smooth and a stable arc can be maintained for generating the heat uniformly.

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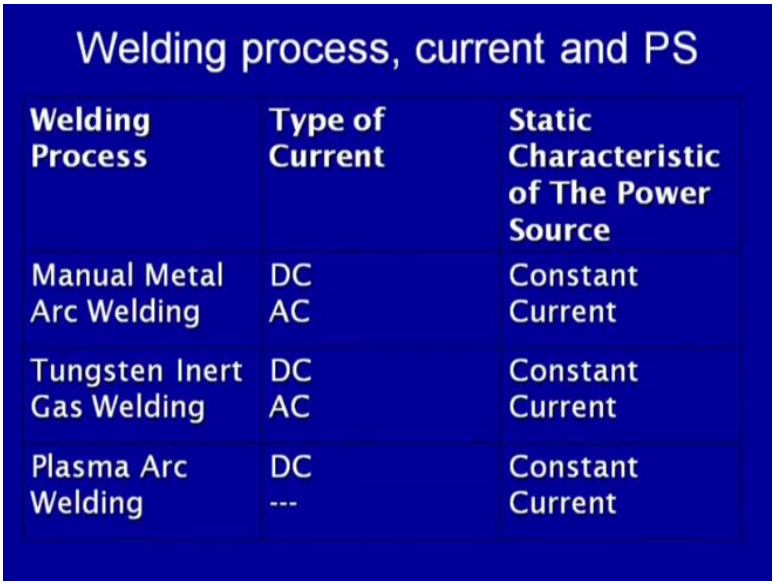

Now, we will see the process wise and what type of current, and what a, and what type of the power source, as far as the static characteristic is concerned should be selected? We know that for the manual metal arc welding process, where there is a possibility of the great arc fluctuation. We can work with both AC current or the DC Current. But mainly the constant current types of the power sources are used, because the fluctuation in arc length a due to the manual control helps to maintain the current largely constant when the constant correct type of the power source is used. So, that the heat is generated uniformly. The uniform well joint with the normal and the uniform properties like penetration weld geometry is obtained.

Similarly, in tungsten inert gas welding process, we can work with both AC and DC Depending upon the requirement. The again the constant current type of the power source is used because the tungsten inert gas welding process is generally controlled using the manual control. There is always possibility of having the fluctuation in arc length. So, to maintain the arc length therefore, to maintain the constant current the constant current type of the power sources is used, so that the uniform heat can be generated.

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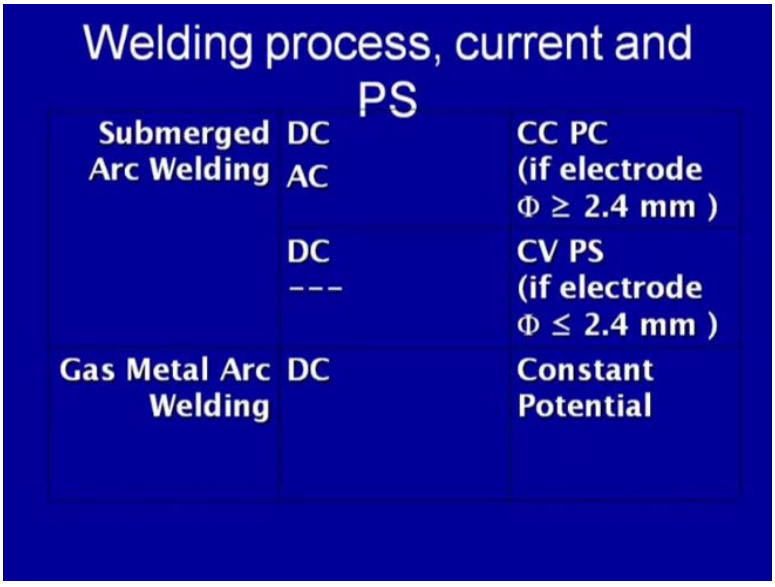

But it can work with the AC or DC. Depending upon the kind of heat control or the cleaning action is required, or the stability of the arc is required. The tungsten inert gas welding with the AC is used, when welding aluminum and magnesium kind of metals for

obtaining the benefit of the cleaning action. But the DC e n is normally used with the tungsten inert gas welding process. So, that the longer life can be obtained and more heat can be generated in the work piece side. Similarly, the plasma arc welding DC is normally used with the constant current static characteristic power source.

So, that the fluctuation in arc length benefit can be obtained, while in case of the sub merged arc welding process DC and AC both can be used. But normally the constant current types of the power sources are used with the large the electrodes greater than 2.4 mm size in case of the steel electrode welding. Because the large meter electrodes, in case of the large diameter electrodes, the constant voltage power source does not help to get the self regulating arc. Therefore, the constant current type of the power source is used so, that the heat remains largely constant due to the constancy in current. When the large diameter electrode is used to take the advantage of the self regulating arc, to maintain the arc length in case of the sub merged arc.

Welding processes DC is used especially, when the diameter of the electrode is lesser than the 2.4 mm size. So, the constant voltage power sources are used for the small diameter electrodes with the DC current supply. Otherwise, a constant voltage power sources are used, with the electrode diameter greater than 2.4 mm size where it is not possible to use the self regulating arc.

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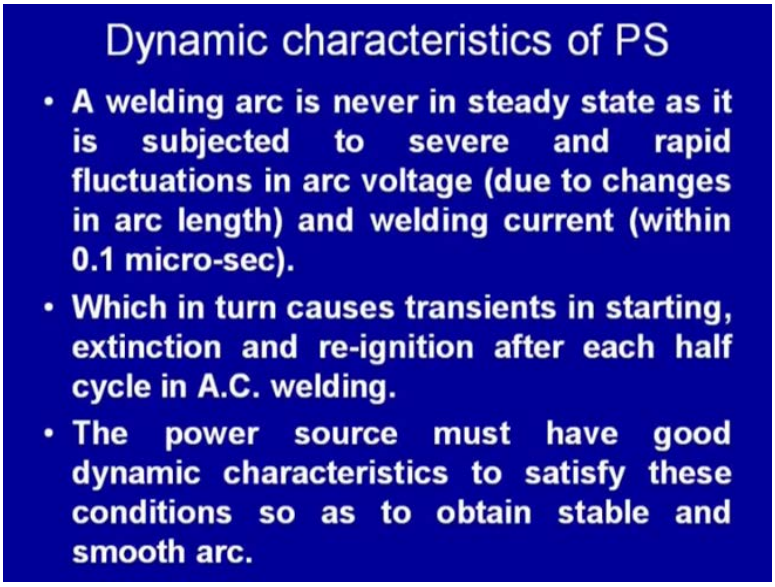

To get this uniform arc length and the gas metal arc welding process. Similarly, constant voltage type of the power source is used. With the DC welding, similarly AC welding can also be used. To, take the advantage of the cleaning action, so the constant voltage a power sources are used with the small diameter electrode. To, take the advantage of the self regulating arc. In order to maintain the arc length the, another characteristic of the power source is the dynamic characteristic, which shows that how rapidly power source response to the change in conditions of the arc welding. We know that the welding arc is very transient in nature as the current and voltage conditions fluctuate very rapidly during the welding so the power source must respond to those conditions very quickly. So, that the desired voltage and the current can be supplied, so has to maintain the desired arc, as we know that the welding arc is never in a steady state. As it is subjected to severe and rapid fluctuation in arc voltage and due to the changes and this mainly happens due to the changes in arc length, and the welding current.

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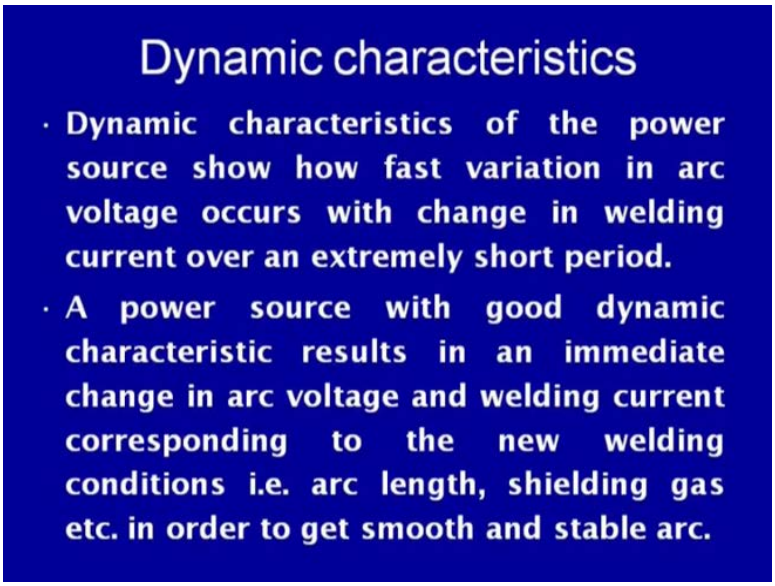

These things change very rapidly, say these changes may be experienced within 0.1 micro second. So, which in turn these transient conditions these, this changes a cause the transients in starting extension and the re ignition after each half cycle. In the in case of the AC welding and the power source must have the good dynamic characteristic to satisfy these conditions. So, has to obtain by smooth and the stable arc. If, the welding power source is not able to deliver the voltage and the current required to deal with the,

with these transient conditions during the welding, then the arc will not be smooth and stable.

It will not be able to generate the heat uniformly at desired or uniform melting of the ((Refer Time: 23:57)) surfaces. To develop the well joint, the dynamic characteristic of the power source shows how fast variation in arc voltage occurs with the change in welding current over extremely short period of time. A power source with the good dynamic characteristic, results in an immediate change in the arc voltage and welding current corresponding to the new welding conditions. That is the arc length or the shielding gas in order to get the smooth and the stable arc.

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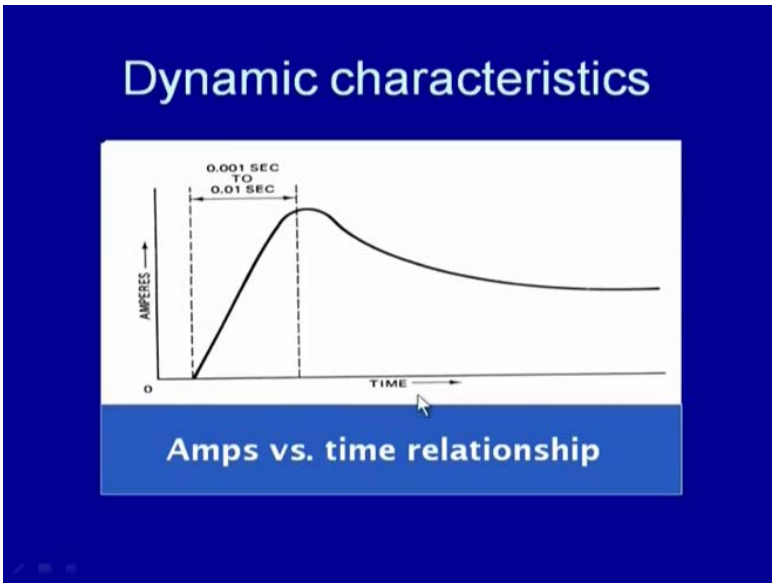

So, that the heat can be generated uniformly and the melting can be obtained as desired. If we see that in x axis, if we see there is a time and in the y axis there is ampere, then you can see that how rapidly it has to increase from very low value to the high value? Within a short period of time ranging from 0.001 to 0.01 second, so this fast response is required from the welding power source to deal with the changing conditions. During the welding if we see, the typical current variation during the welding a metal inert gas welding process where, the variation in welding current as a functional time is shown here.

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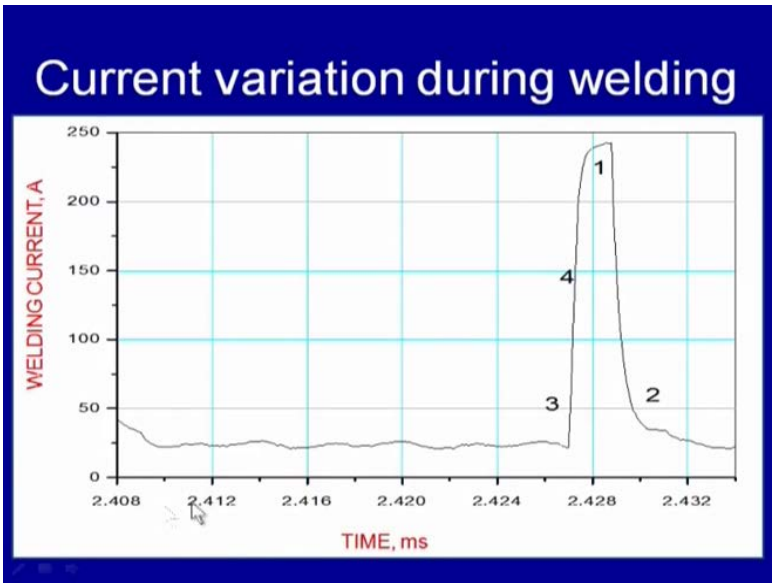

If the kind of transient conditions, which are experienced during the welding we can say there is a sharp change in the welding current over a period of a say very short period of time. Say it increases suddenly, then it comes down and passing through the different stages of a. Due to the fluctuation in arc length and the changing welding conditions. Similarly, here we can see that the how arc voltage fluctuates during the welding over a very short period of the time.

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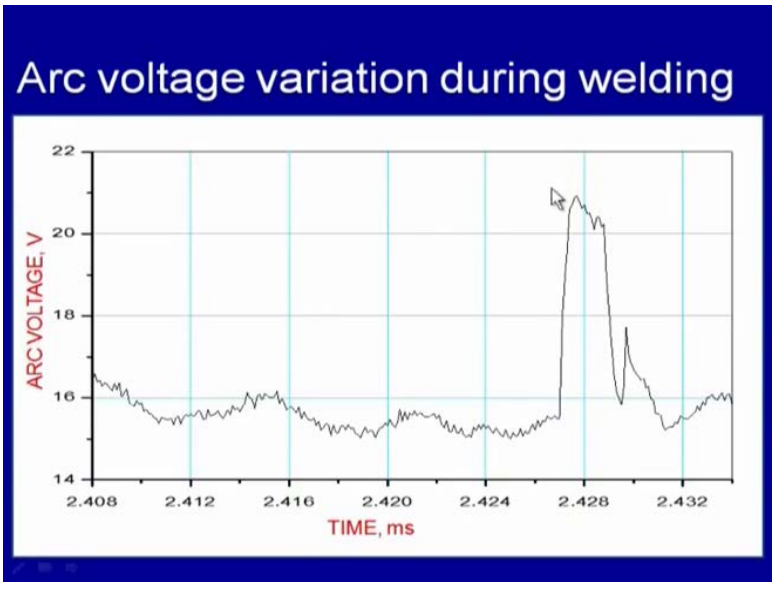

Then it gets stabilized, but however these fluctuations keep on happening. Extend of fluctuation may be very small for a longer period of time. But for a short period of time there are huge variations in the arc voltage as well as arc current, depending upon the kind of the welding cycle being used during the welding. So, your power source must be capable of dealing with these conditions and should be able to meet out the requirement of the welding current, the welding voltage to deal with these the transient conditions during the welding, so that the smooth and the stable arc can be maintained. The high frequency unit is one of the devices, which is commonly used with the welding processes. It, is main role is to deliver the high frequency, high frequency current of the low magnitude at very high voltage.

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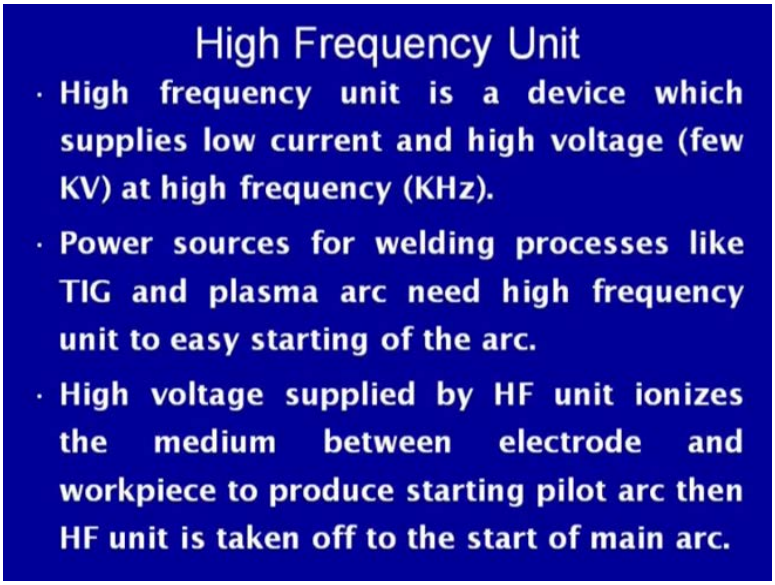

So, that the arc can be ignited very easily in the initial stages once the arc is ignited it is taken off from the welding circuit. The normal welding current is supplied so that the required heat can be generated. So, it is just an accessory which is brought in the welding circuit to supply a pulse of, pulses of the high frequency high voltage low current to the welding circuit. So, that arc can be ignited the high frequency. Unit is a device which supplies the low current and the high voltage of the few kilovolts at very high frequency. So, the power source for the welding processes like tungsten gas and plasma arc welding need a high frequency unit.

For, the easy starting of the arc this high voltage unit supplies, the pulse of the high voltage low current at high frequency, which helps to ionize the gases present between the electrode and the work piece. To, produce the starting arc that is called pilot arc. Once the pilot arc is started then high frequency is taken off from the circuit and the main current supply is brought into the picture, so that the normal welding arc can be brought in for the melting of the ((Refer Time: 28:25)) surfaces.

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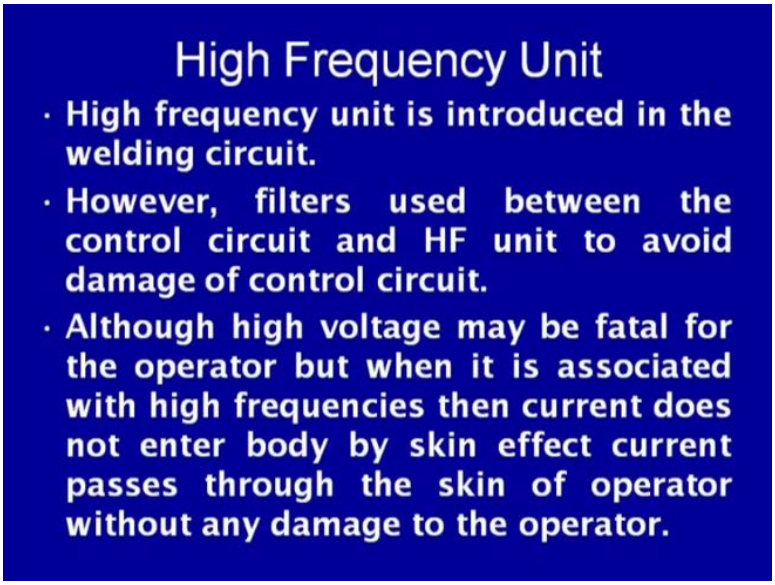

High frequency unit is introduced, in the welding circuit however the filters between the control circuit and the high frequency unit are used to avoid any kind of damage to the control circuit. Although, high voltage may be fatal for the operator, but it is associated with the high frequencies, then the current does not enter into the body, but by the skin effect this current passes through the skin of the operator without any damage to the operator. So, when we use the high frequency current, then it does not pass through the through the body of the operator.

But if by chance if it comes in contact of the high a frequency high voltage current, then this current passes through the skin of the operator. He does not get any shock this is called the skin effect. But it can be otherwise fatal if the high voltage current comes in contact with the operator then it can be fatal. Now, next important characteristic of the duty cycle is of the power source, is the duty cycle. The duty cycle is important in the sense that it helps to the proper selection of the duty cycle.

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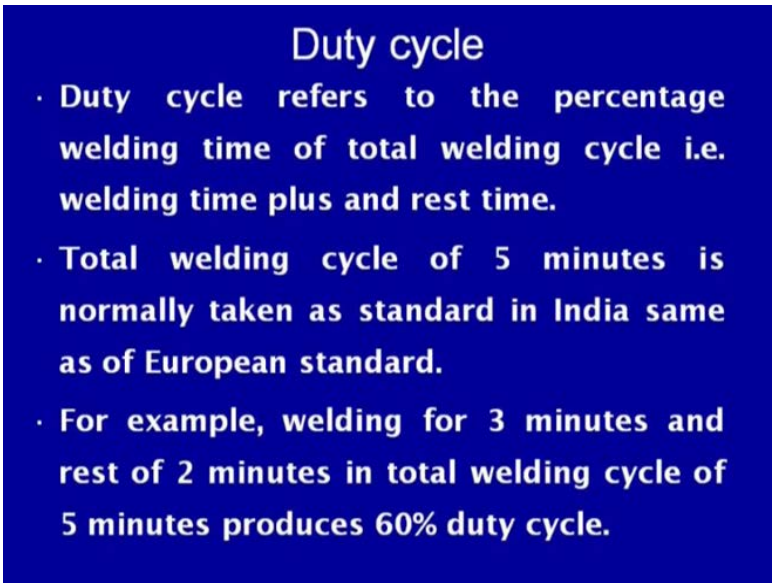

It helps to run the welding power sources for longer durations without any damage, to the power windings or the coils and cables being used in the welding circuit. Because when we draw, very heavy current from the power sources electrical resistance. Heating takes place in the cables and coils. If we continue to draw the current for longer durations from the welding power source, then it can lead to the overheating of the coils and cables which can damage them. Therefore, the welding current is not drawn at very high levels from the power welding, power sources for long duration.

Then what a strategy we should apply for drawing, the heavy current from the welding power sources. That is indicated from the duty cycle, so this the duty cycle. Basically, refers the percentage of the welding time of the total weld cycle time. Which is made of the welding time plus the rest time we cannot run, we cannot draw the welding current all the time continuously, from the welding power source as per our requirement. But, we need to see that what is the capability of the welding power source to deliver the desired current and how long we can draw it?

Otherwise it will get damaged due to the overheating. So, duty is to take care of the, to avoid the overheating and to avoid any kind of the damage to the windings and the coils and cables of the welding power source and the circuits. It is necessary that, the welding current is drawn for short period of time from the welding power source. Then it should be stopped, so that how long time we can draw the current? Then after how long time we

should stop the welding? That is considered in determining the weld cycle. We know that how long time we draw the current from the welding power source that time is called weld time. The time during which no current is drawn, after drawing the welding current from the welding power source is called rest time and the combination of the weld time plus rest time is called the weld cycle time.

So, the ratio of the weld time and the total cycle time gives us the duty cycle. It is always expressed in terms of the percentage. So, there can be various duties a various total cycle times. But as standard in India that total weld cycle time is considered to be of the 5 minutes while in other countries, it is of the 10 minutes also. The total weld cycle time is of 5 minutes as a standard in India and some European countries. For example, if welding continues, means if we are drawing the current for 3 minutes, for performing the welding, from the welding power source and the 2 minute is the rest time.

Then the weld cycle time is 5 minutes. We are, we were, we are working with the 3 divide by 5 which will be giving us the 60 percent duty cycle. So, the duty cycle and the current are very closely associated. And it is important to consider, at what current we are working at what duty cycle because it ensures the power source. It ensures that the power source have been safe. And it is windings are not damaged, because of the overheating. The duty cycle is ratio of the arcing time to the weld cycle time multiplied by 100.

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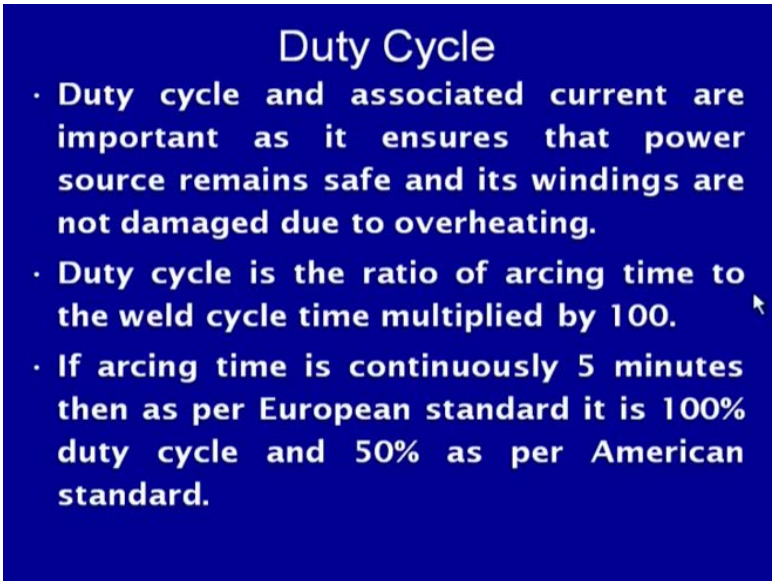

This arcing time is basically the welding time, during which the heat is generated by drawing the current from the welding power source. Weld cycle time involves the arcing time plus the rest time. So if the arcing time is continuously for 5 minutes, then as for the European standard we are working at 100 percent the duty cycle and as per the American standard it the 50 percent the duty cycle.

So, at 100 percent duty cycle means we will keep on drawing the current continuously from the welding power source. So, the current magnitude should not be high if you keep on drawing very high current under the 100 percent duty cycle. It will cause very heavy heating electrical resistance. Heating of the cables and the coils which are being used and they may get damaged because of the electrical resistance heating.

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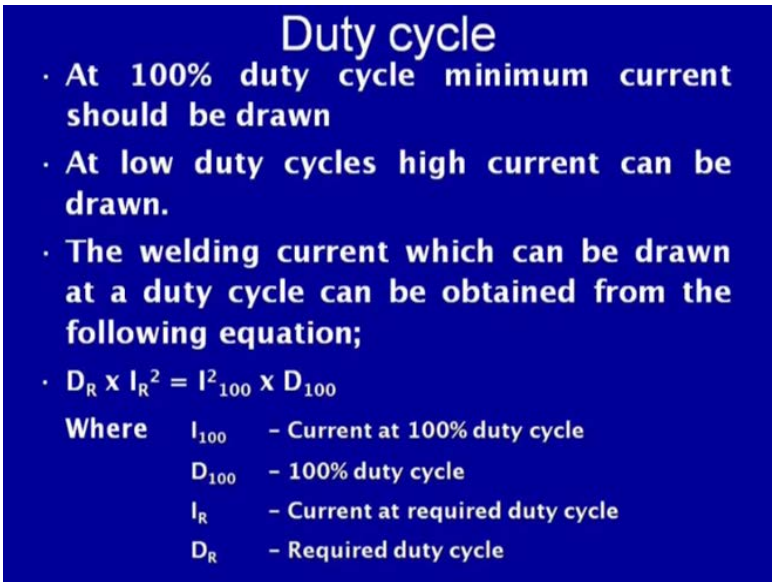

Therefore, whenever we work with the high duty cycle the minimum current should be drawn from the power source, while we can walk with the high current when using the lower duty cycle. So, at low duty cycles we can use the high current from the welding power source. The welding current which can be drawn at a duty cycle can be obtained from the following equation, which basically involves the D R the duty cycle at which we want to work. I R the current which we want to draw and I 100 represent to the current at the 100 percent duty cycle and the D 100 represents to the 100 percent duty cycle.

So, here I 100 current at the 100 percent duty cycle, D 100 percent duty cycle I R current at the required duty cycle and D R is the required duty cycle. So, this using the equation D R into I R square, is equal to I 100 square into D 100 using, if we know any other 3 parameters fourth one can be obtained. So, using this equation if we know the current values, which can be drawn at 100 percent duty cycle and then we can determine the duty cycle, for at a particular current rating or the current, which can be drawn from the power source at particular duty cycle. So, it is important to select that the proper duty cycle is taken at for a given current. If we do not take that as per the requirement, then it will cause unnecessary overheating of the welding coils and cables these can damage.

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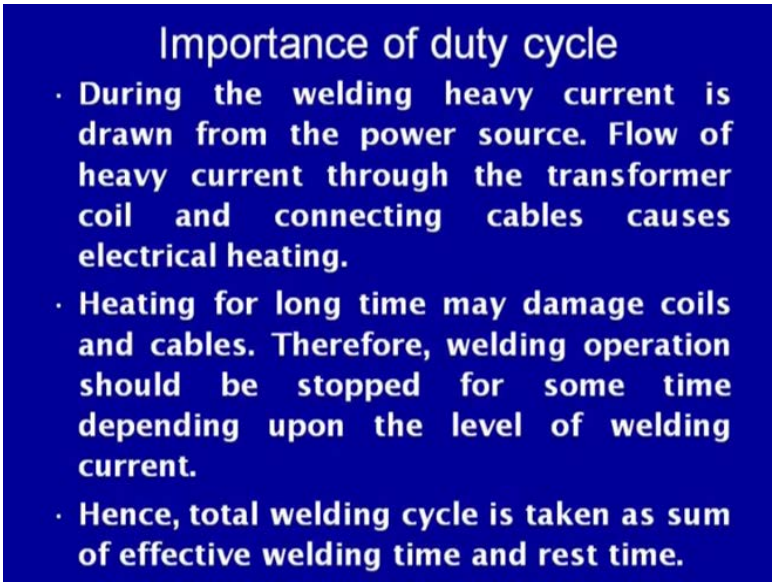

We know that during the welding heavy current is drawn from the power source. The flow of the heavy current through the transformers and coils, and connecting cables causes electrical resistance heating. Heating of the coils for long time may damage the coils and cables therefore; welding operation should be stopped for sometime depending upon the level of the current. So, if you work with the lower level of current there will be lower electrical resistance heating. Accordingly the lesser heat will be generated and that will help us to draw the current for longer duration, which will allow us the higher duty cycles.

So, this is the kind of sequence which exist in, hence the total weld cycle is taken as the sum of effective weld time and the rest time. The effective weld time, if you draw the

current and the rest time there is no current drawn, but whatever electrical resistance heating has been done. That heat is lost to the surrounding and to the cooling medium so that the temperature of the coils and cables can be maintained. So, the factors that affect the duty cycle and there capability to draw the high current that depends upon the maximum current, which, can be drawn from the power source at a particular duty cycle depends upon the size of the wire.

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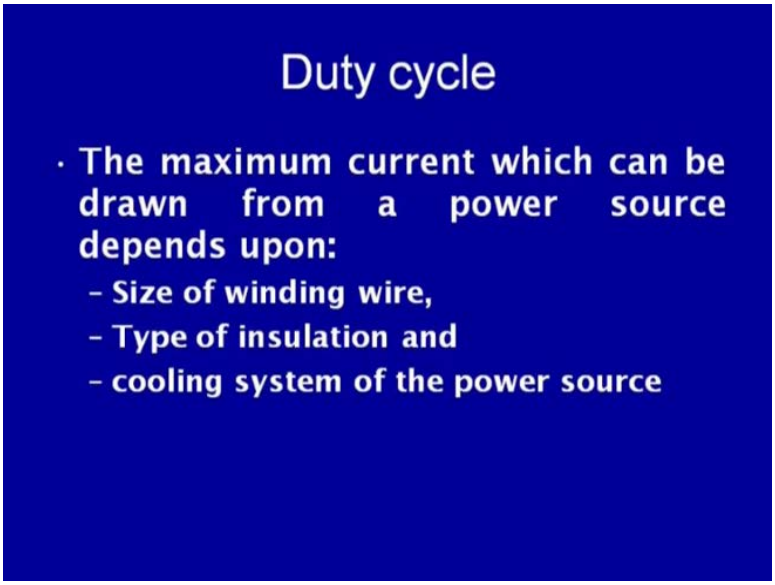

We know that the electrical resistance heating is governed by the kind of the electrical resistance, being offered by the conducting wires and being used in the cables and the coils. If the size of the wires is big then the electrical resistance, to for the flow of current will be low and the low electrical resistance and which in turn will lead to the lesser electrical resistance heating. The reduced electrical resistance, heating will allow the higher the duty cycle or it will allow the, and it will have the greater capability to draw the more current for longer duration.

Similarly, if the electrical the installation of the coils and cable is good then to sustain the electrical resistance heating for long. It will be able to draw the higher current without getting damaged. Similarly, the cooling system is effective it will be able to extract the heat being generated. Because of the electrical resistance heating when welding is done continuously at the high current. So, if the cooling system is effective if the installation is

good. And the, and the size of the wire is big, which arc is offering lesser resistance for the flow of the current.

Then as a whole first electrical resistance heating will be reduced, then capability of the installation to withstand against the heat will be more and third the temperature will be maintained within the limits, if the cooling system is effective. So, if these three things are present and the power source will allow us to draw the higher current, or it will allow us to work at higher current even with the higher duty cycle.

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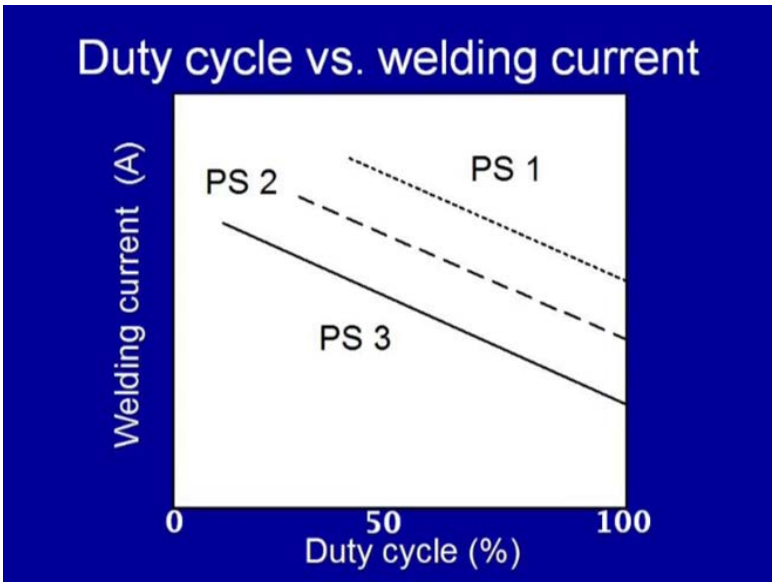

So, in general, if we are drawing the higher current then we need to work with the lower duty cycle. For example, if we see here y axis shows the welding current that we can draw and x axis shows the duty cycle at which we can work at 100 percent duty cycle. We can draw very low level of current for a given power source and this varies linearly, if we keep on decreasing the duty cycle. Then the welding current at which we can work will keep on increasing.

So, the highest is the duty cycle lowest will be the welding current which can be used, Say, if we are having the three types of the power sources with the different types of the conductors of the different sizes, different types of the installations and the different cooling mediums, with the different effectiveness. Then accordingly there will be difference in this line which will allow us to work with and that how much current can be drawn for a given duty cycle. So very robust welding power sources, which are made of

the large the electrodes, very good installation is there and very effective cooling medium exists with them. Then, they will allow the higher welding current even at the higher duty cycle.

While, if the material is made of if the windings and cables are made of the small diameter electrode. If the poor installation, which could not cannot withstand at high temperature then it will not allow to work with the very high welding currents. So, for given duty cycle, if we see the best quality power source will allow higher welding current ,while the poor quality power source will allow a lower welding current under the identical duty cycle. Because the poor welding power source will not have the capability to withstand under the heat being generated during the welding. It will have tendency to get damaged because of the overheating.

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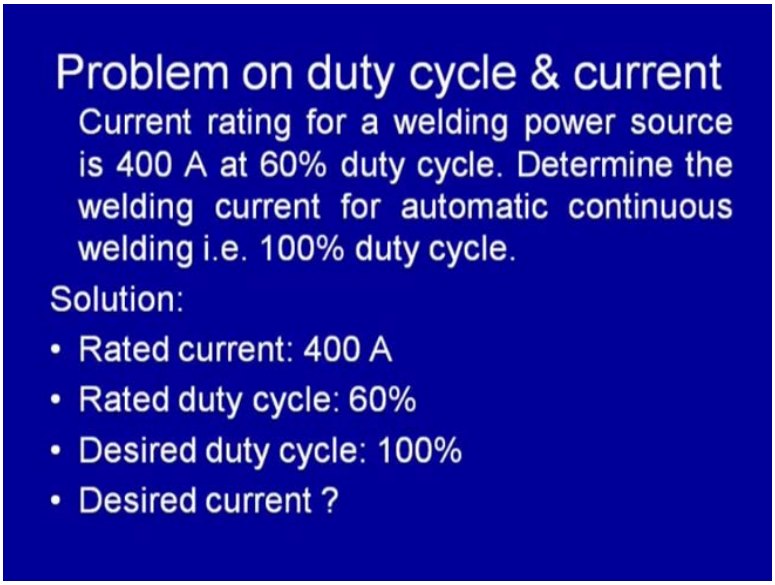

So, now if we see the one typical example to show the importance of the duty, to show the relationship between the duty cycle and the welding current, say if you are working the current rating for the welding power source is 400 ampere at 60 percent duty cycle. Then how can we determine the welding current for the automatic welding process, where 100 percent duty cycle is used? So, we have the rated current 400 ampere rated duty cycle 60 ampere desired duty cycle continuous welding. That is 100 percent duty cycle and the desired current at the, for the automatic welding process is to be obtained.

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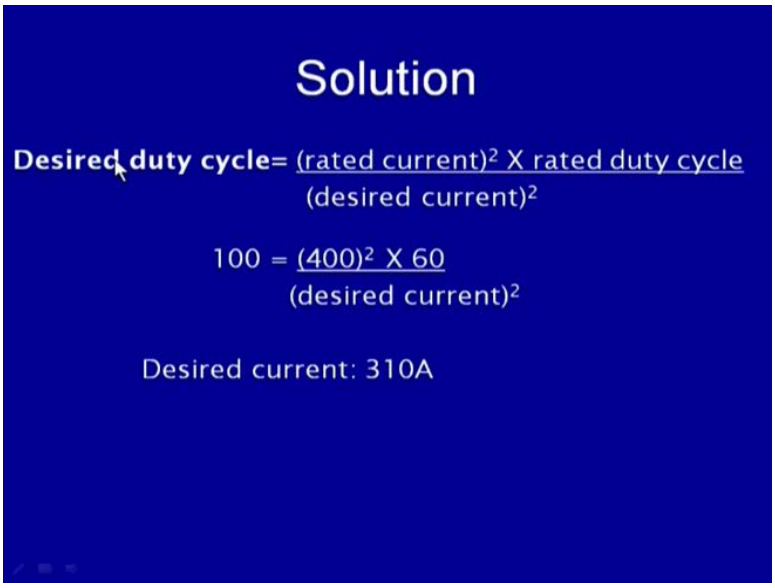

Then the then, we can by putting the value of the different parameters, which are there, the desired duty cycle is 100 percent rated, current is 400 ampere, rated duty cycle is 60 and the desired current is a required. So, by solving this equation we can obtain the desired current say it is coming at 100 percent duty at 60 percent duty cycle. The current is a 400 ampere, while at the 100 percent duty cycle current will be lower, so it is coming at 310 ampere. The last characteristic, which plays a significant role in determining the duty cycle of the welding power source is a class of insulation. Class of insulation indicates that how much heat, it can resist without getting damaged during the welding.

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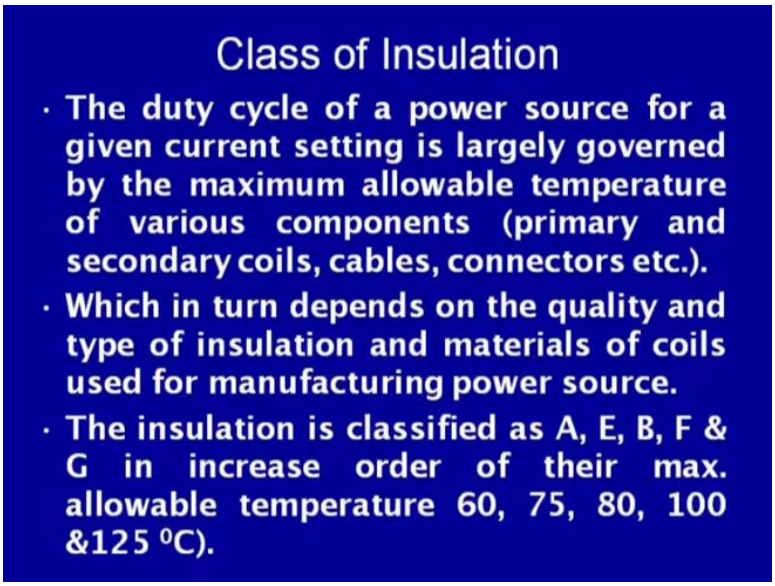

Better is the class of the insulation being used for making the welding coils and the cables higher will be the duty cycle. That power source can offer a duty cycle of the power source, for a given current setting is largely governed, by the maximum allowable temperature of the various components. This components like primary and secondary coils cables and connectors, which in turn depends upon this high capability to withstand at high temperature, of these components depends upon the quality and the type of the insulation being used.

The materials of the coils being used for manufacturing these power sources, so if the better is the class of the insulation higher will be it is ability to withstand at higher temperature. For example, a class there can be different classes of the insulations. They will have different capabilities to withstand at different temperatures. Say, insulation is classified has A, E, B, F and G these are in increasing order of their maximum allowable temperature. Say A 60, degree centigrade E 75, B 80, F 100 and G 125 degree centigrade. So, the A, class insulation will have the maximum allowable temperature of 60 degree.

So, it will have minimum resistance to the heat, maximum resistance to the heat. Temperature generation will be offered by this G, class insulation which can withstand up to 125 degree centigrade. So in terms of the duty cycles, if we see the A, class insulation will allow us the lowest duty cycle and the minimum current.

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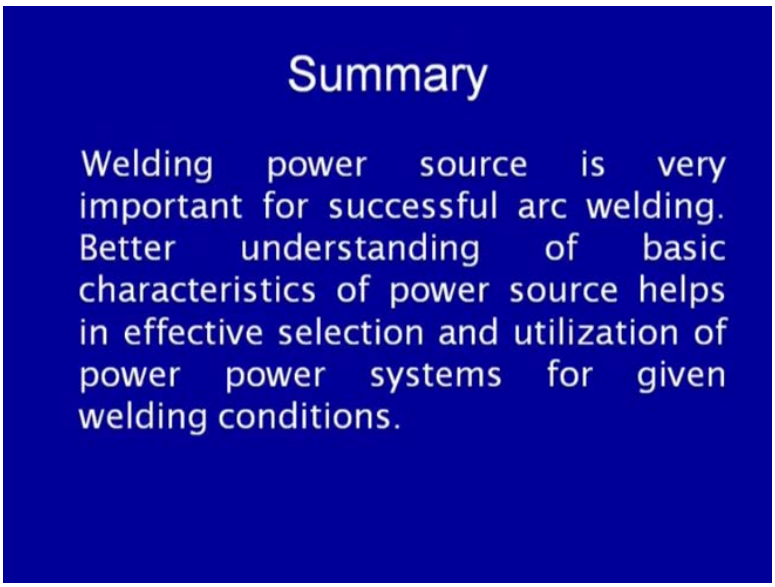

While the G, class insulation will allow us to go for the higher duty cycles in with the higher welding current. So, this is how we can see in this presentation, we have seen the static characteristics of the power sources, dynamic characteristics of the power sources, high frequency unit importance of the duty cycle and the class of the insulation. Now, we will summarize this lecture through this summary. We know that the welding power sources are very important for successful welding, because it is necessary that heat is uniformly generated .So, that how constant heat, constant and uniform heat can be obtained with the help of the proper kind of the welding power source. So, we for that we can select constant current type, constant voltage type or rising characteristic type of the power source. How can we maintain the arc length for that purpose?

We can use self regulating arc or the feed drive system with the variable feed motors for better understanding of the better of the basic characteristic of the power source. We, know if we have the better understanding of the characteristics of the power sources. It will help in selection of the selection of the proper power source for given application and utilize the power systems for the given welding conditions. So this is how it complete summary of this presentation.

Thank you for your attention.