Welding Engineering
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Module - 03
Welding Power Source
Lecture - 01
Types of Power Sources and their Characteristics – I

Dear students, you know that for the fusion arc welding process we need to use the heat of the welding arc and the heat generated by the welding arc is governed by the welding current under the arc voltage. So, that the continuous and smooth flow of the current can be maintained and the sufficient potential difference between the electrode and work piece can be maintained. What we have seen in the previous lecture that what are the factors that affect the melting rate of the electrode and how to initiate and maintain the arc and what are the things important for having the smooth and controllable arc.

We know that for having the smooth and controlled arc it is necessary that the required amount of the welding current is supplied at the correct voltage and this is achieved by using suitable welding power source. So, in this presentation mainly we will be talking about the different types of the power sources which are available, along with their specific applications.

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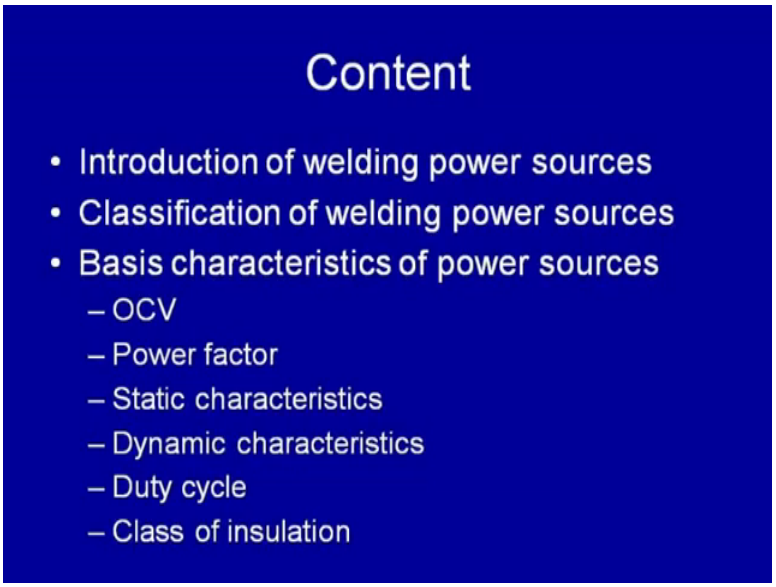

The characteristics of the welding power sources which are important for selection of the proper kind of the welding power source, so that the successfully smooth and sound weld joint can be made. As presentation is concerned we will be looking at different aspects related to the power sources, like that what is the need to use a specific kind of the power sources for the welding purpose. So, that is about the introduction of the welding power sources and what are the different ways through which we can classify or group the welding power sources.

The important characteristics of the welding power sources that affect the welding and development of the sound weld joint, that is why understanding of these electrical characteristics of the welding power sources is important. These characteristics include the open circuit voltage, they are commonly known as the o c v and the power factor which is indicating the effectiveness with which the power is used. The static characteristics indicates the way by which the welding current and the voltage will be related with each other during the welding when the arc length is changed under the pure resistive load conditions.

The next is the dynamic characteristics which indicates that how promptly power source will respond to the changing welding conditions, especially arc length during the actual welding. Because the welding arc is considered to be the very honest stable and very transient conditions are experienced as far as variation in welding current and the work voltage is concerned. Duty cycle is the, another factor that indicates that how long time we can use the welding current from a power source at a particular level of the current.

So, the, this duty cycle primarily indicates the time for which a current can be drawn from a welding power source in a cycle of 5 minutes or 10 minutes. So, that the level of current which is drawn from the power source directly affects this time duration. It is important especially in case of the continuous arc welding processes where the welding continues for more than 5 minutes or 10 minutes continuously. Under these conditions the welding power source must be robust and good and should have the good stability under the high temperature conditions.

So, that the insulations another coils do not get damaged and it performs for long and continuously without any break. This, the performance of the welding power source, under the high temperature conditions is especially governed by the class of the

insulation which is used in the windings of the welding power sources. So, the class of higher class or the better class of the insulation indicates the better resistance of the insulation being used in windings of the welding power sources. So, that they can withstand under the higher, under the severe working conditions of when high current is withdrawn or welding is done continuously. Better insulation results in the higher duty cycle under the identical current conditions.

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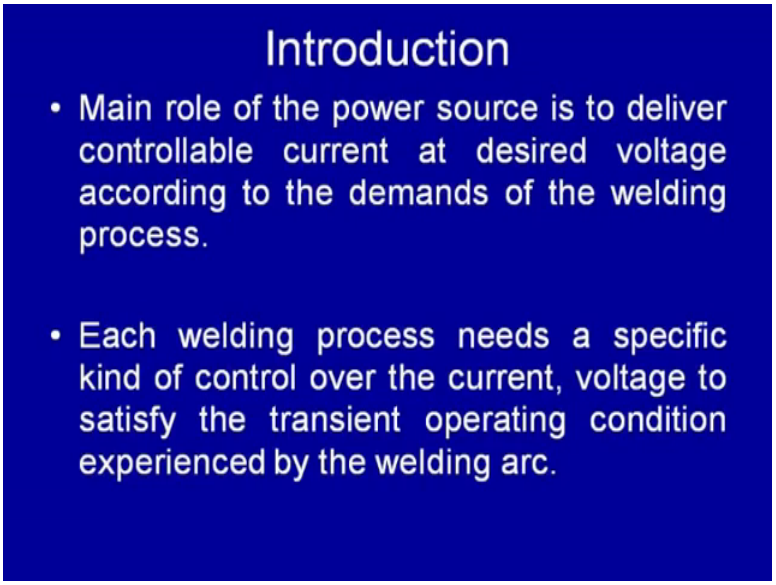

Now, we will we will looking in to the welding power source and its specific kind of needs. We know that the major role of the welding power source is to deliver the controlled amount of the currents at a particular rate, so that the desired voltage, under the desired voltage conditions, so that the demand of the welding process can be fulfilled in for having the smooth and stable arc.

The main requirement is to have the desired amount of the welding current from the power source at the correct voltage, so that a smooth and stable arc can be achieved. If there is a continuous fluctuation in the current and voltage then it will be difficult to have the smooth and uniform heat delivery from the welding arc, which will make the weld joint of uneven kind with the different penetration and the different rate of the metal depositions. That is why it is necessary that the welding current is delivered under the controlled conditions at the desired voltage, so that the smooth and stable arc can be maintained.

We know that the each welding process works under the specific conditions of the welding current and the voltage. That is why the requirement these requirements vary significantly with the process to the process. Few welding process use very low level of current and very smooth current is desired of specific time. For example, the gas tungsten arc welding process uses very low current and mainly and generally of the direct current type however the AC current is also used.

Similarly, in a metal inert gas processes and the submerged arc welding processes the voltage constant voltage is largely used while the current can vary significantly for maintaining the arc lines through the use of the self regulating arc principle. So, the kind of control which is being used in a particular process or the voltage requirements which are there associated with the particular process to deal with the transient conditions experienced by the welding arc during the welding.

It is necessary that is that the desired current and the voltage is supplied by the power source during the welding and it is supplied in the way it is required because the conditions during the welding are very transient. They change very at vary fast rate, that is why it is necessary that the dynamic characteristics of a, the welding power sources very good.

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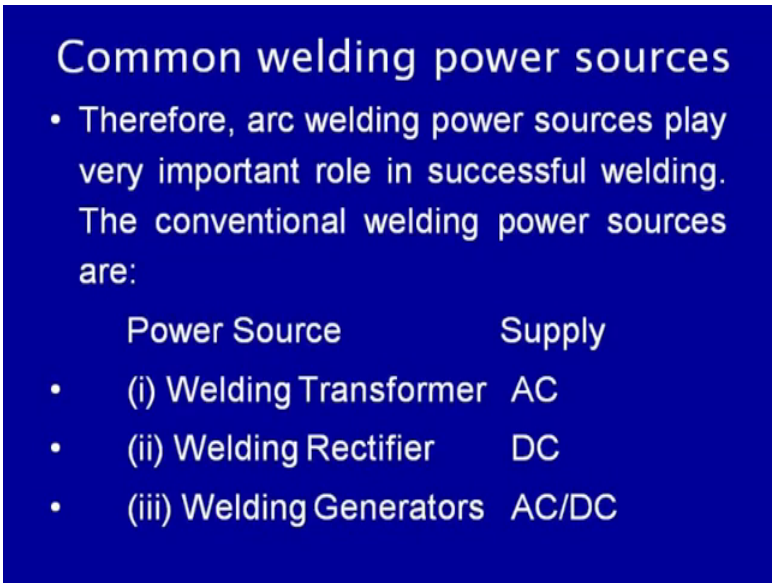

We know that they are variety of the welding power sources are available in the market and each type of the source have the different capability. The common types of the power

sources include, like the welding transformer which delivers alternating current and this is one of the most commonly used the powers welding power source. Most of the general purpose welding or in the job shops welding transformer is invariably used for development of the weld joint, because this is very cost effective welding powers source and it is easily available.

The welding rectifier delivers the DC current and this is used especially when the welding is done under very controlled conditions or very better control over the heat generation is desired. For example, the welding of the aluminum magnesium or the stainless steel the welding generators are also available which can supply the AC and DC. These are mainly used when the normal supply is a not available or the sites are located far away from the power generating units, where normal power supply is not available.

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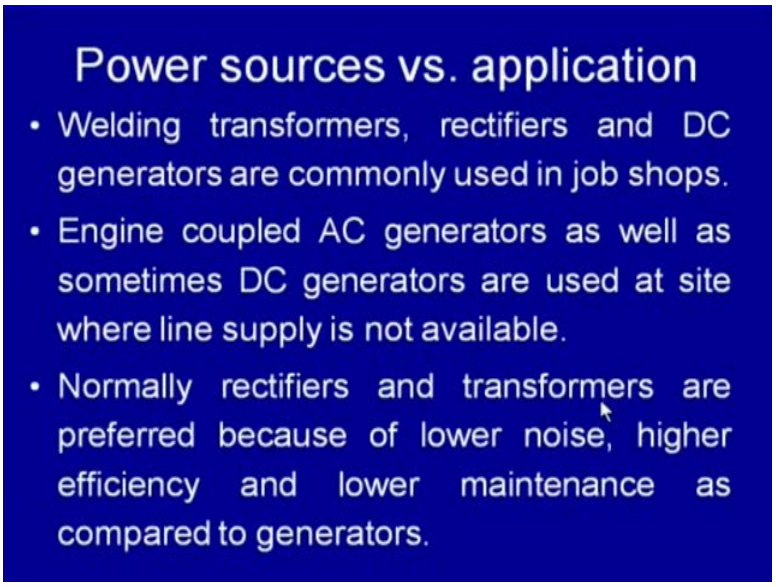

So, as for as application of the specific kind of the power source is concerned welding transformers, rectifiers and the DC generators are used in job shops. While the engine coupled AC generators as well as the DC generators are used at the site where normal power supply is not available. And the normal reactors and the reactors and transformers are preferred over the generators. Because they are noisy and their efficiency is poor and they require lot of the maintenance. While the rectifiers and transformers are rectifiers and transformers do no cause much of the noise and the efficiency is higher. The

maintenance requirement is also less and that is why the rectifiers transformers are preferred over the generators due to these benefits.

Now, which type of the power source should be used under a given set of the conditions that depends to, that to a great extend depends up on the type of current to be used for the welding. We know that the depending up on the metals to be joined and thickness to be joined, our requirements may vary significantly. For thicker sheets we want that more heat is generated in the work piece side, while for the consumable arc welding process where we want high deposition rates. The high amount of the heat is required in the electrode side so depending up on the requirements we may use AC or DC type of the current.

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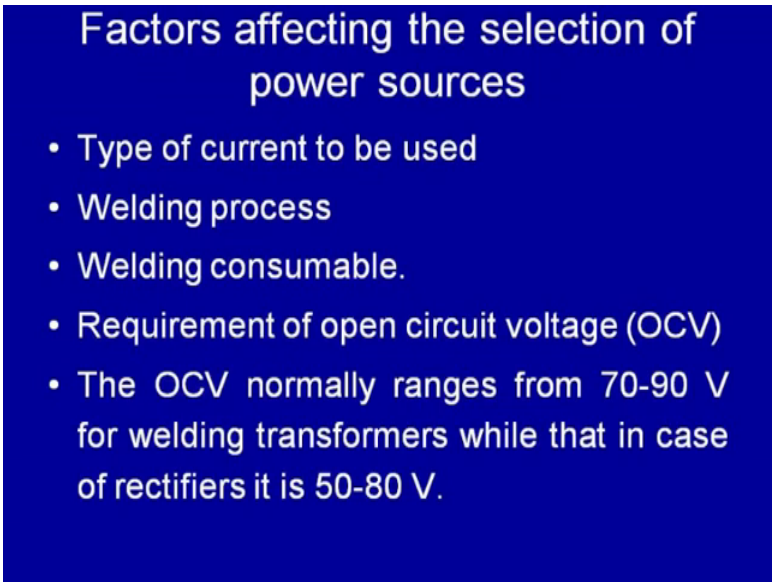

For example, in tig welding of the aluminum cleaning is a important so the magnesium and the aluminum welding is normally done using the AC current while other wise or while in other cases the DC current is used for the welding purpose. So, if we want AC or DC or both kind of options are required then accordingly the power source is is selected which can deliver the desired type of the current. The welding process, some of the welding processes like the shielded metal arc welding process, the shielded arc welding process, or a if the current each welding process works in certain range of the current.

Say shielded metal arc welding process works a 100 amperes to the 800 amperes range.

So, the power source should have the capacity to deliver that kind of the current. While the submerged arc welding process requires the higher current then the GTA and the metal inert gas welding process. For example, the submerged arc welding process normally work with 200 to 2000 ampere current.

So, the welding power source must be able to deliver the current in that range at that desired voltage. Some of the welding processes require low current lower current then the other processes and according to the requirement of the current and their ability to deliver the desired control amount of the current during the welding, the suitable welding power source is used. The welding consumables also, sometimes dictated the kind of power source which is to be used.

For example, for having the self regulating arc in case of the metal inert gas welding processes and the submerged arc welding processes it is desired to have the small diameter electrode of a the material to be of the welding electrode to be used for the welding purpose. So, for obtaining the self regulating welding arc using the small consumable electrodes in case of the GMAW and the submerged arc welding processes the constant voltage power sources are used instead of the constant current type of the power sources.

Similarly, the large dielectrodes require the constant current type of the power sources for uniform deposition of the material. Another factor that affect the selection of the power sources is the ability to deliver the desired open circuit voltage open circuit voltage is one which is available between the terminals of the power source when there is no flow of current and the load is pure resistive. So, under these conditions what is the open circuit voltage which can be delivered by the power source for a that affects the selection the of a particular power source. Say for example, for GTAW process we need the low lower open circuit voltage is as compared to that of the shielded metal arc welding process.

So, shielded metal arc welding process, can means requires as high as the 100OCV, while in case of the GTAW process it is lower about thirty to forty volts. So, the OCV generally ranges from 70 to 90 for the welding transformers, while in case of the rectifiers its lower because in case of the rectifiers which supply the DC currents the magnitude of the current and the direction of the current flow remains constant. That is

why we do not require much high open circuit voltage to have the smooth and stable arc to reignite this. When it is extinguished, while in case of the welding transformers which deliver the higher, which deliver the alternating current.

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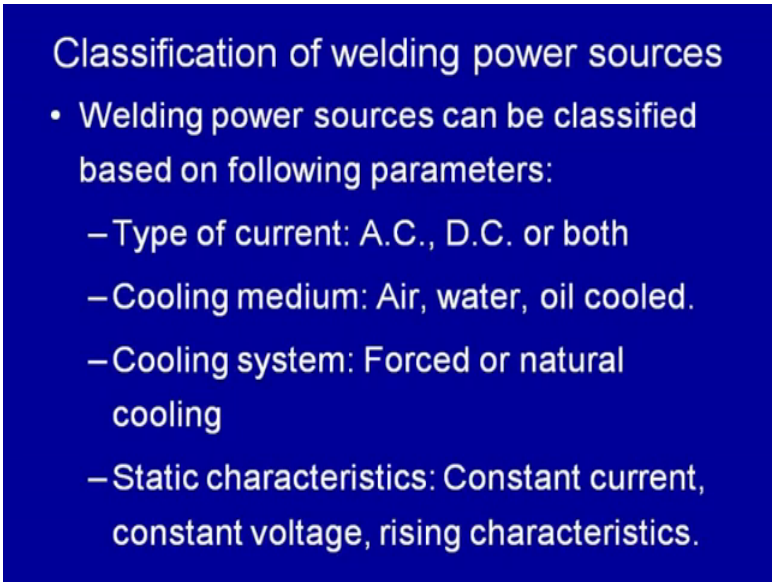

Alternating Current like the AC, the welding AC, welding power source DC welding power source or the both welding power source can deliver the type of. So, based on the type of current we can have the AC power source DC or one which can deliver both type similarly. Based on the cooling medium which is used to maintain the temperature of the windings of the power source within the limits so that it can work for long without getting damaged.

So, various cooling mediums are used for maintaining the temperature of the power sources within the limits and this cooling can be achieved either through the ambient air or by circulation of the water or the cooling or cooling oil is used to maintain the temperature. Where all, where you see air water or the oil will be used as a medium to cool down to extract the heat being generated during the flow of current while welding is done and based on that we can have the air cooled power sources or water cooled or oil cooled the power systems which are used for the welding purpose.

Now these systems may work on the two approaches one is the forced another is natural in the forced system. Some mechanism is used to have the controlled and desired flow rate of the cooling medium like air water or the oil. So, that the heat is extracted at the

rate which is desired while in case of the natural cooling. The natural, because of the natural convection currents the heat is extracted by the cooling medium from the windings of the power source so that their temperature is maintained.

So, under the severe working conditions where lot of heat is generated, because of high current is withdrawn from the power source. The force cooling is required while in case of the low welding current systems, where the current not much current is withdrawn from the power source not. So, the not much heat is generated during the welding and the temperature of the windings of the power source can be maintained even by the natural cooling process which is based on the natural convection of the air water or the oil which is being used.

The, another the way by which we can classify the welding power sources is the characteristic of the power source when there is a pure resistive load between the terminals of the power source and there is no flow of the current under these conditions. Means under t pure resistive load conditions in which way welding power transformer responds to them, variation in current and voltage during the welding or when the current is withdrawn that leads to the further division in form of the constant current type of the power source constant voltage type of power source or rising characteristic type of the power source.

So, in case of the constant current type the variation in voltage due to the arc length variation results in minor change in the welding current. And that type of power source is termed as the constant current type while in case of the constant voltage type minor change in the arc length causes the significant change in the welding current. But, the voltage remains constant while in case of the rising type of a, the characteristic power source the, there is a minor increase in the voltage with the increase of the welding current. Practically, the constant voltage is made available when the rising characteristic power source is used because the constant voltage power sources shows a decline in the voltage being offered with the increase of the welding current.

So, the field of application of each type, of the type each, type of the power source is different and they are depending upon the mechanism by which the smooth arc is, smooth arc is stabilized and produced for a developing the heat at uniform rate. Under the kind of current which is withdrawn during the welding the kind of voltage which is to

be used for having the smooth and easy ignition of arc and smooth maintenance of the arc. The kind of a, the metal to be welded and the electrodes to be used all these factors must be considered while selecting the suitable type of the power source. So, now we will look in to the greater details of a, the basic characteristics of the power source.

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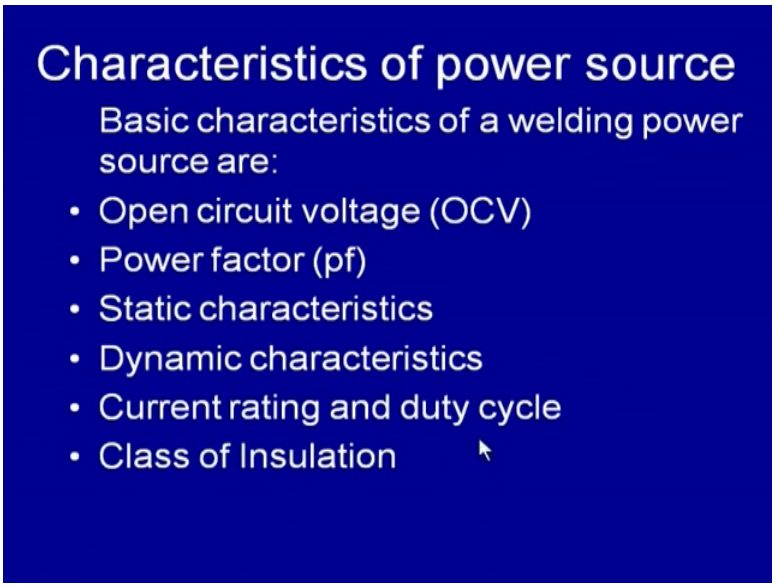

You know that the, these basic characteristics of the power sources include the open circuit voltage which facilitates that how easily arc can be ignited. When there is, when it is either extinguished or it is to be ignited in the beginning. The power factor indicates the effectiveness with which power is being used, during the welding and the static characteristics. As I have just described indicates that how the welding voltage varies with the change of the welding current or under the, under the conditions when there is a pure resistive load and how rapidly power source response to the changing conditions during the welding in respect of the arc voltage and the welding current.

That indicates the dynamic characteristics of the power source current rating and the duty cycle of the other and the class of the insulation. So, now we will see that open circuit voltage to be selected first while using a particular power source for developing the welding arc. It is necessary that the proper open circuit voltage is set first before igniting the arc so that it can be initiated easily and maintained properly during the welding but, the proper setting of the open circuit voltage is governed by the kind of electrode which is being used the type of current to be used.

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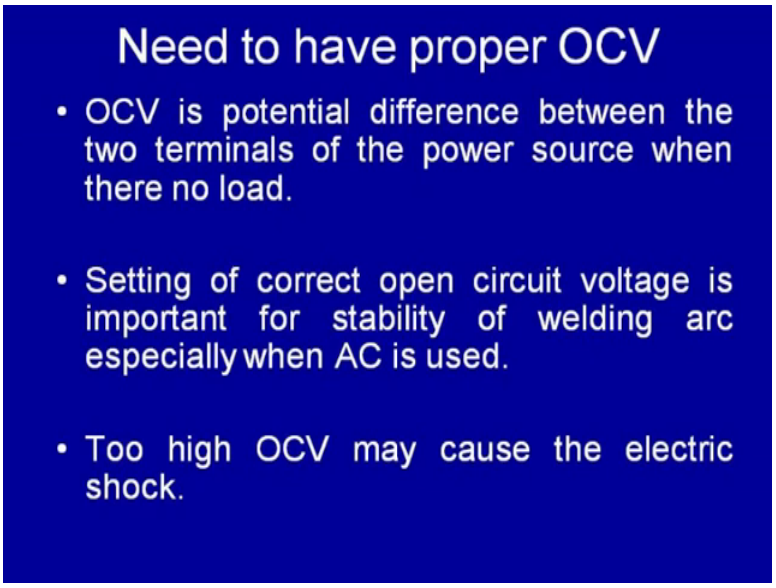

And the shielding gasses being used if we have to work with the bare electrode and the shielding gases, having the higher ionization potential and the no low ionization potential elements are present with the electrode then it is required to set a the higher open circuit voltage. Similarly, the AC current requires the higher open circuit voltage as compared to the DC current. It is necessary that proper open circuit voltage is set in the open circuit voltage refers to the potential difference between the two terminals of the power source when there is no load and the setting of the correct open circuit voltage is important to have the smooth and stable welding arc especially when welding AC current is used.

So, because when AC current is used the magnitude under the direction during the welding continuously change and under these conditions arc will have the tendency to get extinguished if the high open circuit voltage is not used, but the too high open circuit voltage like if the 100 volts may have the tendency to give the electric shock while working. So, it is not considered to be desirable while using the high too high open circuit voltage, but the setting of the optimum open circuit voltage is important for stabilizing the arc and to initiate it easily during the welding the open circuit voltage to be used during the welding depends up on the type of metal to be used the metals having the low ionization potential requires the lower open circuit voltage.

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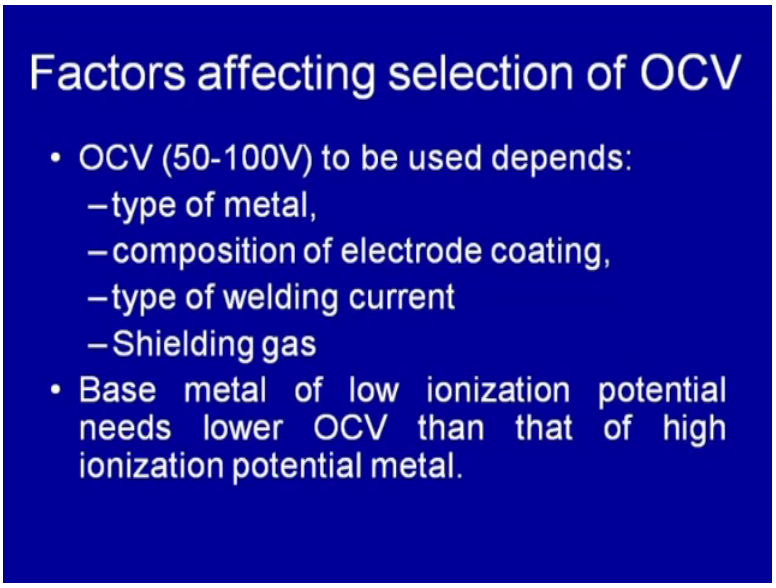

Than those have the higher open circuit higher ionization potential so the metals like titanium metals will require the lower open circuit voltage than the other metals. Similarly, the composition of the electrode coatings having the low ionization potential elements like a, the calcium and potassium and they will require lower open circuit voltage than the electrodes without the presence of these low ionization potential elements.

Similarly, the type of the welding current the DC current requires the lower open circuit voltage than the AC current because in case of the DC current, the current once the arc is ignited the current magnitude and its direction remains unchanged and a smooth and continuous flow is maintained easily while in case of the AC current, the current and magnitude of the current and its direction continuously change in every half cycle and that is why arc has a tendency to get extinguished.

Especially, when the current is 0 that is why to reignite the arc it is necessary that the open circuit voltage is higher than that is used while welding. With the DC shielding, gas also affects the selection of the open circuit voltage because the gases like helium which have the higher ionization potential requires the higher open circuit voltage than the other shielding gases.

So, the selection of the shielding gas, the type of welding current and the composition of the electrode coating and the type of metal to be welded affects the optimum setting of

the open circuit voltage must be shown in proper so that it is neither too high nor too low because too high open circuit voltage will tend to give the shock while too low open circuit voltage will have the tendency to get the arc is, so that arc is extinguished to avoid any extinguishing of the arc. The lower side open circuit voltage should not be the too low, the base metal of the low ionization potential elements needs the lower open circuit voltage than that of the high ionization potential metals this is what I had just explained as far as the factors affecting the selection of the open circuit voltage is concerned.

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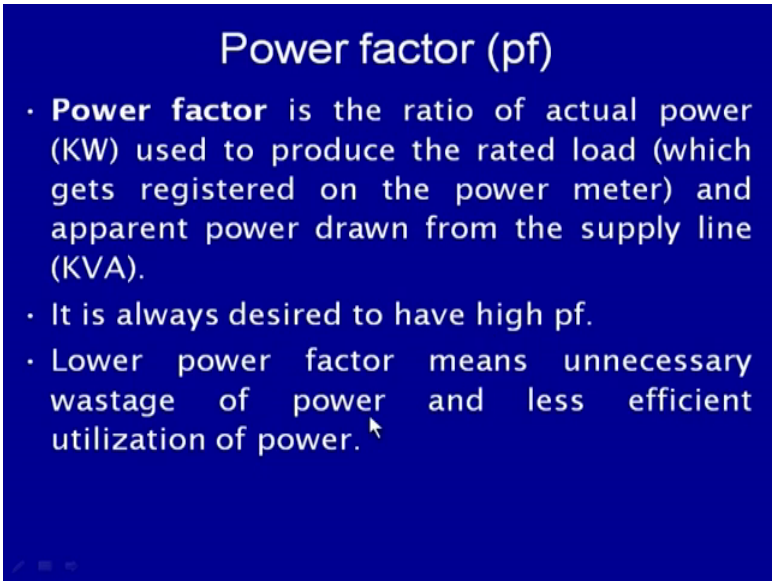

Now, we will see that how open circuit voltage is different from the arc voltage we know that open circuit voltage is one which is the potential difference between the two terminals of the power source when there is no flow of the current while arc voltage is one means the potential difference between the electrode tip and the work piece when there is a flow of current. So the arc voltage is always lower than the open circuit voltage and another important characteristic of the power source is a power factor. Power factor indicates that how effectively the power is being used in a organization so it is indicated by the ratio of the actual power being used to produce the rated load and apparent power drawn from the supply line.

So, ratio of these two actual power divided by the apparent power being drawn from the power supply indicates the power factor, it is always desired to have the higher power factor so that the power can be effectively used. The lower power factor suggests

unnecessary wastage of the power and less efficient use of the power in an installation but in case of the welding sometimes we intentionally use the lower power factor, so that we can have the desired smooth stable arc welding transformers with the low power factors.

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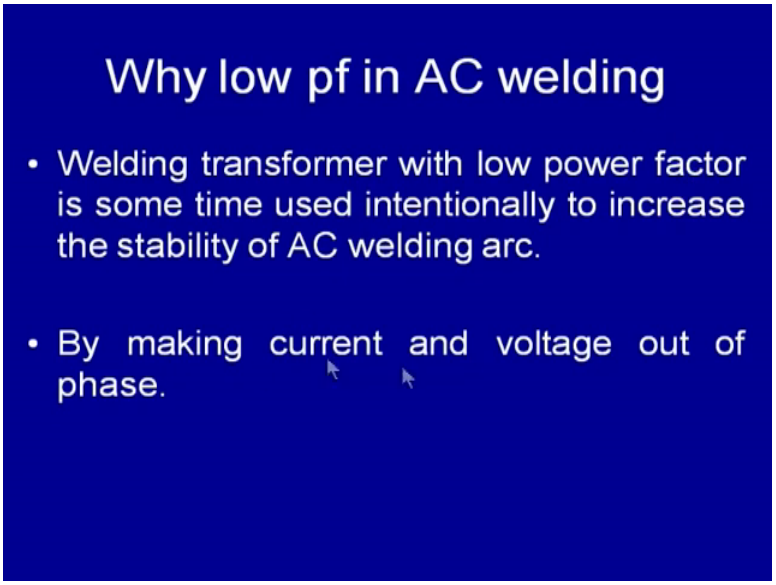

Sometimes intentionally used to increase the stability of the welding arc specially when AC is used, so this smooth stability is obtained by making the current and the voltage pulse is out of the phase. So, that when the current is 0 the maximum voltage is available for re-ignition of the arc. Especially in case of the AC welding with the use of the welding transformer as a power source, the low power factor power source help us having the welding current and the voltage out of the phase in such a way that when current is 0 and the maximum voltage is available the arc is reignited automatically high while the high power factor which is normally preferred in the installations where electric power is used.

Because high power factor reduces the reactive power in the system which in turn decreases the power consumption and so the power cost. So, it is always desired to have to reduce the power cost associated with the power and the power consumption high power factor helps to reduce the power consumption which in turn helps in reducing the power cost related with the power.

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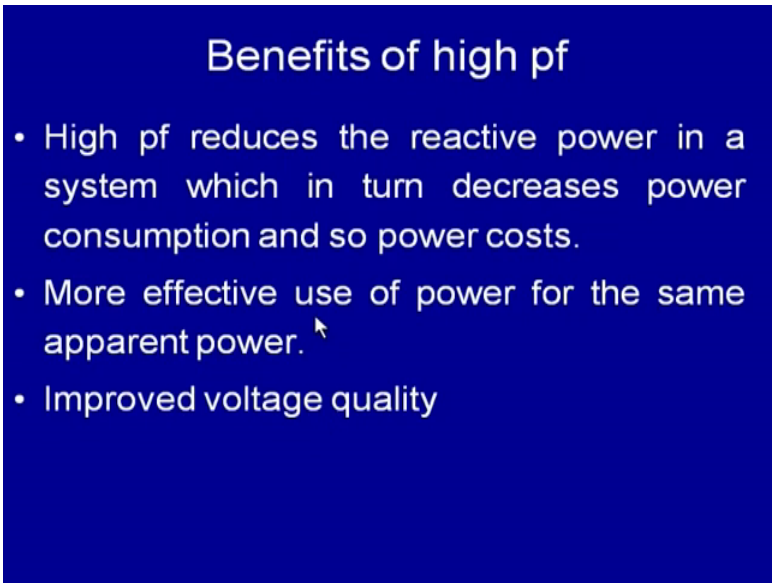

And it also suggest or indicates the more effective use of the power for the same apparent power being drawn from the supply line. Further, it also helps in getting the improved voltage quality, so it is good to have the higher power factor of the welding power source. But when it is required that the current and the voltage are out of phase, the lower power factor is intentionally used in the welding power sources, so that the arc can be reignited specially if it is extinguished when the current is 0.

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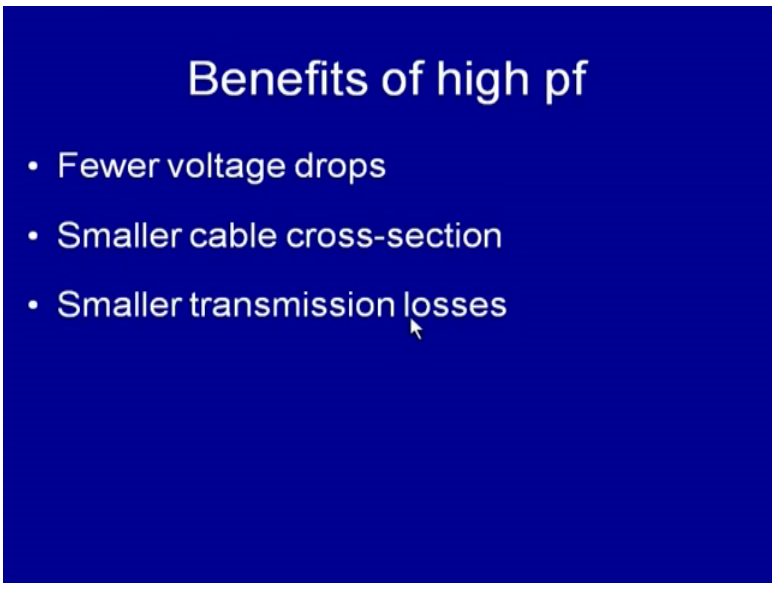

When using the AC welding there are few other benefits of the high power factor, like it will be leading to the fewer voltage drops and the smaller cable can be used. The cable having the smaller diameter cross section can be used for drawing the current and the transmission losses are also reduced. So, all these things are in favor of reducing the investment as well as consumption of the power. While using the high power factor of the static characteristics of the power source we will be focusing now, which will be indicating that how the current variation in current leads to the variation in voltage while welding under the different conditions.

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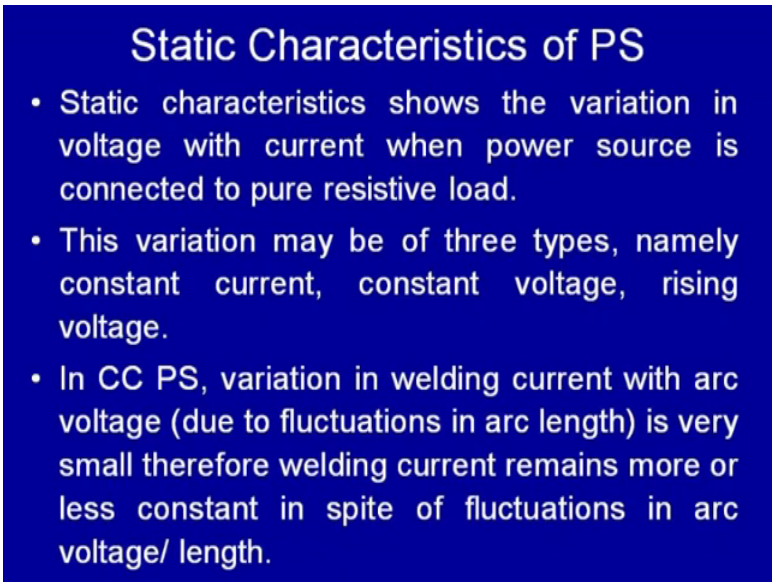

And these variations will lead to have the different types of the power sources with the different types of the static characteristics associated with the kind of, different kind of the power sources static characteristics show the variation in the voltage with the current. When the power sources connected to the pure resistive load this variation may be of three types which is generally observed the constant current type constant voltage type and the rising voltage type.

In the constant current type of the power sources that is the CC for constant current and PS for the power source the variation in the welding current with the arc voltage if the fluctuation in arc length. If it is occurring is very small, so the main thing associated with this is that the welding current fluctuates very less even with the fluctuation in the arc

length. Therefore, welding current remains more or less constant and in spite of the fluctuation in the arc voltage or the arc lengths.

Main benefit of this constant current type of the power source is that the variation in welding current is very small even when they were there is a variation in arc voltage or variation in arc length. So, that the heat is generated uniformly at the same rate melting rate of the electrode remains same and the penetration remains unchanged and this leads to help in development of the uniform weld build under and the weld joint having the better characteristics. So, under the conditions when there is a fluctuation in arc length due to the manual control or the fluctuation in arc voltage from the power supply. These type of the power source helps in obtaining the largely constant current welding for the welding purpose so that the good and sound weld joint can be made.

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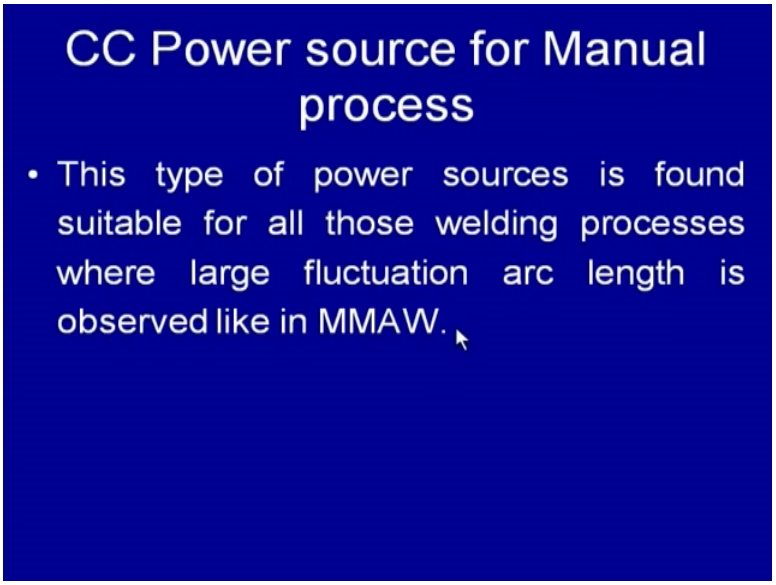

So, the constant therefore, the constant current type of the power source is mainly used for the manual processes because in manual processes there is always fluctuation in the arc length and the fluctuation in arc length leads to the variation in arc voltage. And the variation on the arc voltage with this type of the power sources do not cause much of the variation in welding current and that is why this type of the power sources are commonly used with the manual metal arc welding processes.

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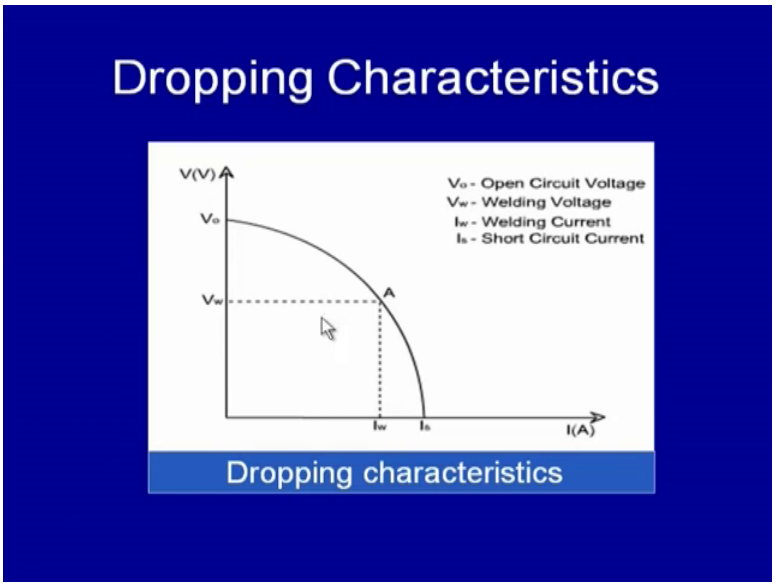

If we see schematically, this diagram here Y axis indicates the voltage and the X axis indicates the current. So here if you see, the when the current is very low the voltage is high and it keeps on decreasing and decreasing. So this slope actually indicates the way by which increase in current will decrease the voltage. If we see here, very small change in the current will be leading to the large change in the voltage or indirectly we say that if we change the arc lengths significantly so the change in voltage will be occurring but, the change in voltage will not be causing much change in the welding current.

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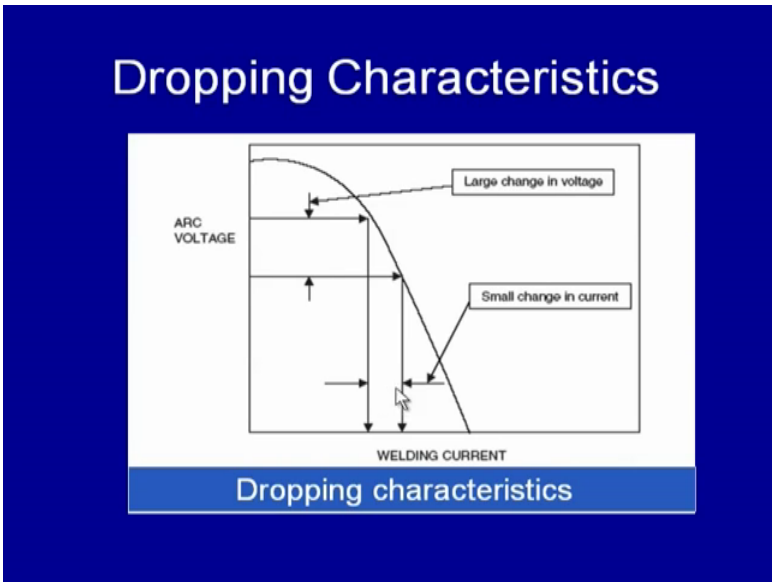

So, the current will remain largely constant or the variation in voltage will remain will be very small. So, this is good for generation of the heat at uniform rate and there will not be much fluctuations in the heat generation, so that uniform weld joint can be obtained. So, this kind of variation in the arc voltage with the welding current where we have the negative slope of this relationship between the arc voltage.

And the welding current we say the dropping kind of the characteristic here if we see that, due to the fluctuation in arc length. If this is the kind of change in arc voltage is taking place from this low level to the high level with the increase of arc length then it will be causing the minor change in the welding current from this level to this level. So, increase in arc voltage due to the increase of arc length will be decreasing the welding current by small magnitude. So, the small change in current will be occurring while the change in the voltage is significant. So, indirectly what we say is, due to the variation in arc length if the large change in the arc voltage is taking place than the change in current will be very small which will not be affecting the heat generation to the greater extent and that is why uniform heat generation will help in obtaining the smooth and the uniform weld joint for the better performance to see this further how the change in arc length will be affecting.

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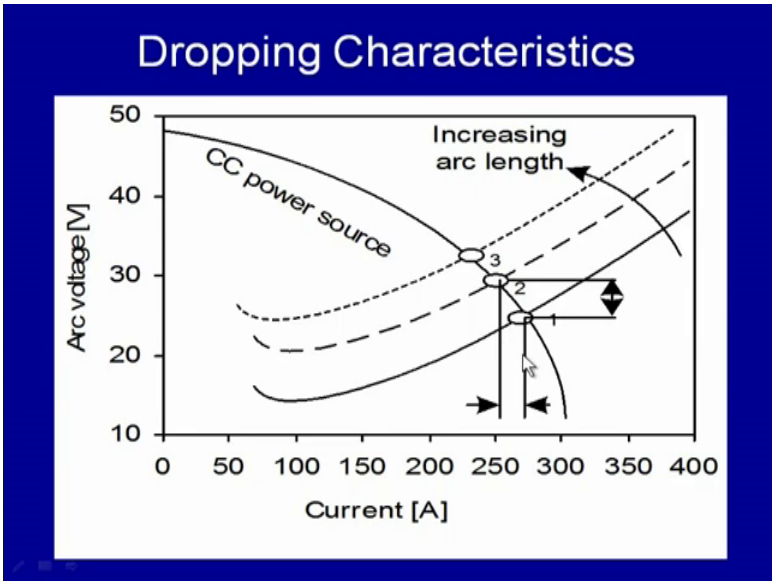

The weld arc voltage and the welding current , this diagram indicates the relationship between the characteristics of the power source, that is the CC power type of power

source cost the static characteristics of the power source is shown by this line having a negative slope. This and these dotted lines and this firm line indicates the arc characteristic.

So, interaction or you can say intersection of the arc characteristics any arc characteristic line with the power source characteristic line indicates the operating point where like for a particular condition, if this is the arc characteristic for a particular arc length say l 1 then the operating point is 1 this indicates that for this operating point the voltage arc voltage is this much, while the welding current is this much. So, if due to any reason if the arc length is increased, we will be having the greater different welding conditions with the increase of arc length. Arc characteristic is shifted on the higher side, so if you see the second line indicates the arc characteristic with the higher arc length.

So, intersection of the arc characteristic with the higher arc length and the, with the characteristic of the power source will be leading to the development of the, another operating point that is the operating point 2. So, in simple words if we say, if we increase the arc length there will be change in operating point from the 1 to the 2. So this change in operating point from 1 to 2 which is being basically developed due to the change in the arc characteristic for the same power source characteristic and intersection of the two leading to the intersection at some other point. If we observe closely this variation due to the increase in arc length, the intersection that is operating point is shifting from 1 to 2 and here if we observe the increase in arc voltage is taking place with the increase of arc length by this much while the increase in the decrease of welding current is very marginal.

So, this is small variation in the welding current will not be affecting the heat generation significantly and it will be accommodated very easily even under the conditions when the great fluctuation in arc length is taking place, similarly there can be further increase in the arc length. We will be shifting operating point from the 2 to 3 and this 2 to 3 will also be increasing the arc voltage without decreasing the welding current significantly, so this is the advantage of the constant current type of the power source.

So, depending up on the slope there can be different dropping characteristics of the power source. So, it is always desired that so that the greater change in the arc voltage will be resulting the smaller change in the welding current ah So, the volt ampere output

curve for constant power source are called the dropper because of their negative slope and that is why these arc called dropping characteristic of the power sources. With the change in arc voltage the change in current for this type of the power source is very small.

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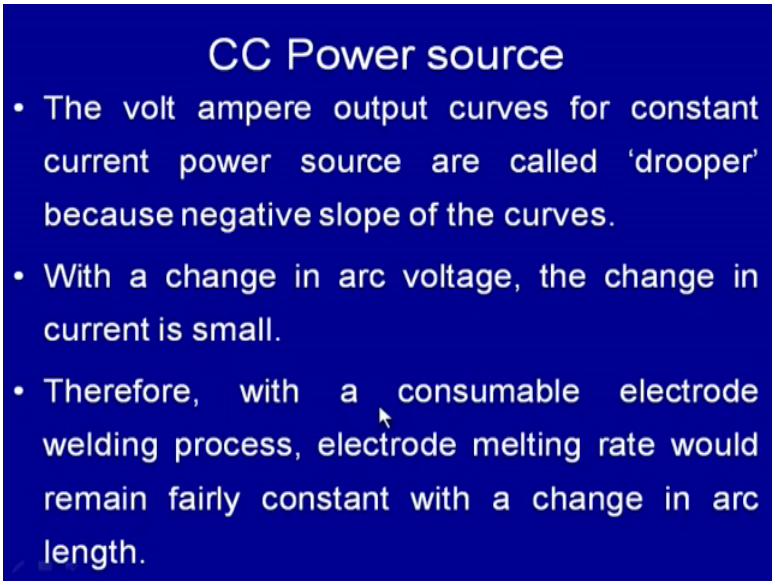

Therefore, with a consumable arc welding processes the electrode melting rate would remain fairly constant with the change in the arc length because heat generation is governed by the welding current and the welding current remains constant even with the change of the arc length and that is why the electrode melting rate would remain fairly constant. Further, another important point with the constant current type of the power source is the short circuiting we know , short circuiting can take place during the welding due to the carelessness or short circuiting is done intentionally while initiating the welding arc.

Electrode is touched with the base metal and then it is taken away from the work base metal so that arc is ignited by the touch start method. So, in case of the touch start method, electrode is intentionally brought in contact with the work piece and the short circuiting is done. While short circuiting can happen due to the carelessness while doing the welding. So, in both the cases it can be damaging to the power source if very heavy flow of the current starts through the coils of the power source, so in this case the limited short circuit current is achieved in case of the constant current power sources and this

limited short circuit current helps to avoid any kind of damage to the power source. And this is very good feature related to the constant current type of the power sources.

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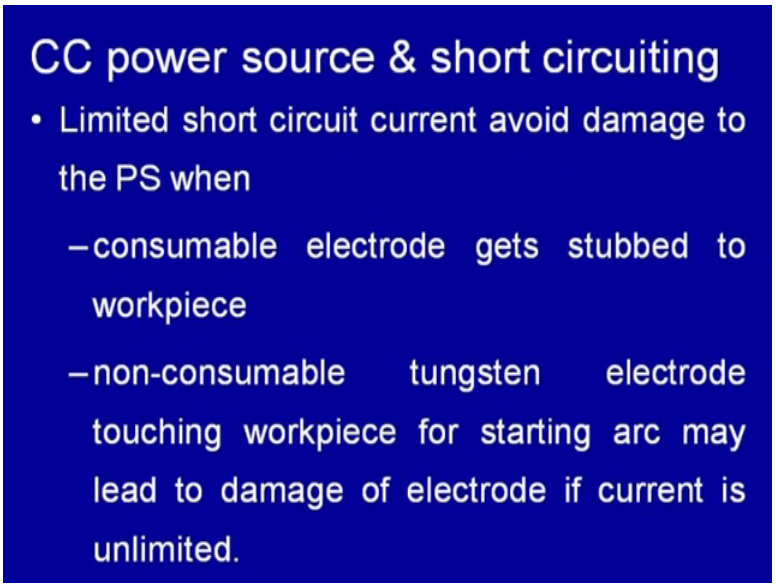

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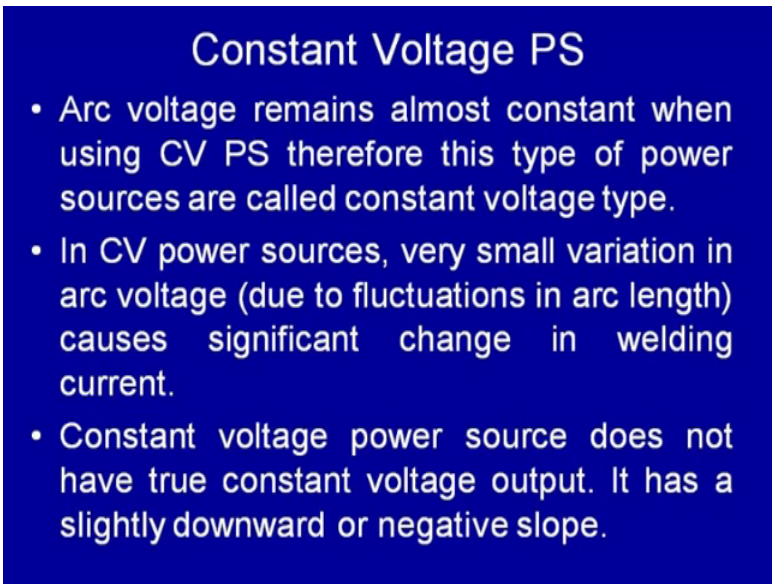

This can happen when the consumable electrode gets stuck to the work piece or non consumable electrode like tungsten is brought in contact with the work piece for starting the arc and this can damage to the electrode if very unlimited or very high flow of the current starts. So, especially when we are working with the GTA welding process it is desired that heat generated while igniting the welding arc is not much but the sufficient

number of the electrons are generated, so that it can be initiated easily without causing much damage to the electrode tip. Now, we will see another important characteristic of the power source that is constant voltage power source.

Which means we can have the constant current type of the power source or we can have the constant voltage type and the power source is with the rising characteristic type, so we have seen the constant current type of the power source where variation in arc length causes the variation in arc voltage without much change in the welding current that helps in developing the smooth and stable arc and uniform weld joint.

While in case of the constant voltage power sources arc voltage largely remains constant when the constant voltage power source is used and that is why this type of power source is called the constant voltage type in the constant voltage type of power sources very small variation in arc voltage due to the fluctuation in arc length causes a significant change in the welding current. So, this is just opposite to that of the constant current power sources. In the earlier case large change in the arc voltage was causing small change in the welding current while in this case a small variation in the arc voltage causes the significant change in the welding current and this aspect is exploited to have the self regulating arc. So, that arc length is maintained automatically during the welding when using the constant voltage power sources.

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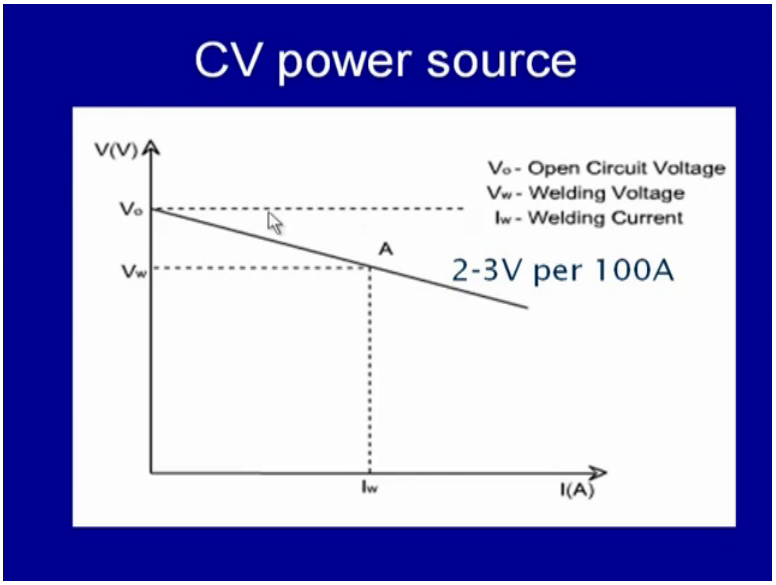

The constant voltage power sources does not have the true constant voltage drop because the relationship between the voltage and the current does not have the horizontal line, but it has slightly sloping downward side. And because of this slightly downward side these do not offer the true constant voltage output and this is we can see that the theoretically constant voltage power source should offer the characteristic of this kind. But, actually does not offer of a this kind of relationship here with the increase of the welding current there is a marginal decrease in the arc voltage and this decrease is about 2 to 3 Volt for per 100 Ampere current.

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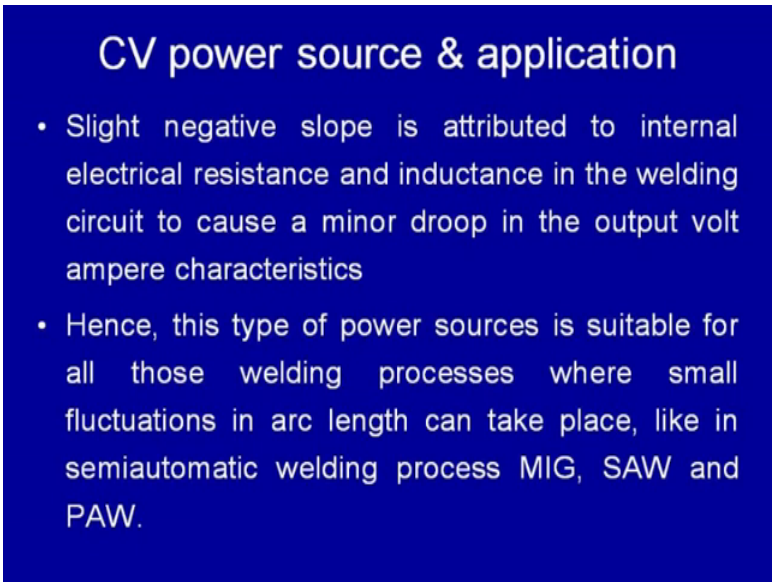

So, although these are the constant voltage power sources but, there is a minor decrease in the arc voltage with the increase of the welding current and this minor decrease in the voltage. With the increase of welding current is attributed to the internal electrical resistance and inductance in the welding circuit which causes minor drop in the output volt ampere characteristic.

So, the slight negative slope is attributed to the electrical resistance and the inductance related aspects related with the welding circuit. Which cause minor drop in the output voltage ampere characteristic and this, hence this type of the power source characteristic is found suitable for all those welding processes. Where a small fluctuation in arc length can take place like in the semi-automatic welding process, like metal inert gas welding submerged, arc welding and the plasma arc welding.

So, here this type of power source, therefore is mostly preferred for those welding process where it is desired to maintain the arc length and the small fluctuation in arc length. Causes the great change in the arc length and this is used to regulate the welding current significantly. So, that the arc length is maintained. Hence, this type of the power sources are suitable for those power sources where fluctuation in arc length is not much.

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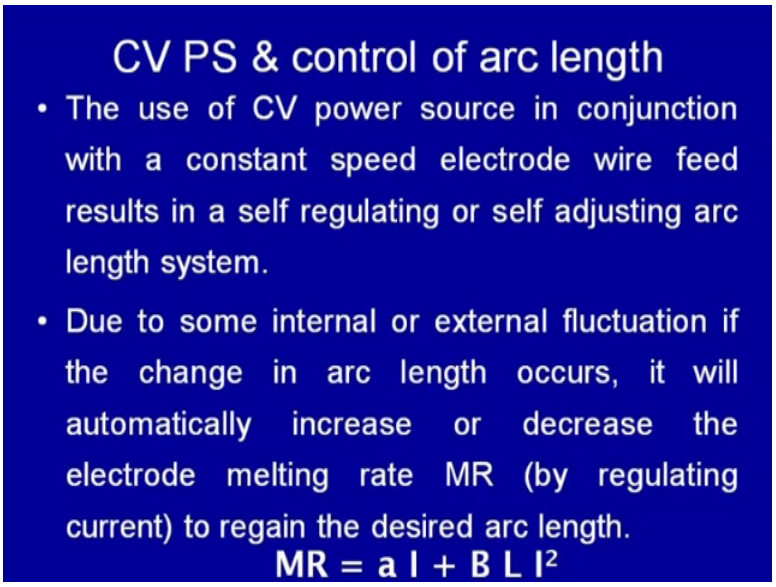

So, how to, how this is achieved to maintain the constancy in arc length while using the constant voltage power source in conjunction with the constant speed. Electrode wire feed system this kind of combination results in the self regulating arc and the self regulating arc automatically produces the adjustment in arc length so that it remains constant.

So, to have the self regulating, self regulating arc a combination of the constant voltage power source coupled with the constant speed electrode wire feed system produces the self regulating arc system. Especially when the electrode resistivity is high and the diameter of the electrode wire is small and we know that under these conditions when there is any fluctuation in arc length due to any reason. Then this causes the increase in the arc voltage, and the increase in arc voltage or decrease in arc voltage causes a significant change in melting current by regulating the significant change in melting rate by regulating the welding current in order to achieve the desired arc length. So, the, this melting rate we know that is regulated by the, a i plus b l i square here.

For the small diameter electrodes having the large electrode extension and the high resistivity, the second factor of the melting second factor governing the melting rate is significantly influenced by the welding current. If the welding current is increased in big way then it regulates the melting rate significantly. So, in under these conditions when on a due to the fluctuation caused by any reason if the arc length changes this change in arc length changes the arc voltage. And the change in arc voltage associated with the constant voltage power sources regulate the current in significantly. Significant increase in the welding current causes the change in the melting rate and this under the conditions of the constant feeding of the electrode wire. If the regulate if the melting rate is regulated then this combination helps to obtain the self regulating arc or the constant arc length.

I will summarize this presentation, in this presentation we have seen that the how the welding power sources are different from the other domestic power sources which are used to get the power and what is the need to have the specific kind of the power sources for the welding purpose, on what basis we can classify the welding power sources and the we have also looked into the details of some of the characteristics of the power sources, like the open circuit voltage and its importance power factor of the power source and the static characteristic of the power sources.

Further, we will see the other characteristics of the power source like in the next presentation and these characteristics will include the class of the insulation the dynamic characteristics of the power source and the remaining static characteristic of the power sources like the application of the constant voltage power source for obtaining the self regulating arc and the different types of the feed drives which are used in combination with the constant voltage type voltage type power source or constant current type of the power sources so this what we will be looking into the next presentation. Thank you for your attention.