Fundamental of Welding Science and Technology

Dr. Pankaj Biswas
Department of Mechanical Engineering
Indian Institute of Technology, Guwahati

Lecture - 07
Welding Power sources characteristics-1

In the last class, I at last I discuss the different duty cycle of a power source Welding Power source. And its rating depending upon the rating and power sources whatever the different classification of welding power source that also I have discuss in details in last class. Today I am going to deliver a lecture on welding power sources characteristics; that means, what is the characteristics of a welding power source? General whatever the welding power sources we are using it has some characteristics what is that characteristic? The related to that characteristic today I will deliver a lecture.

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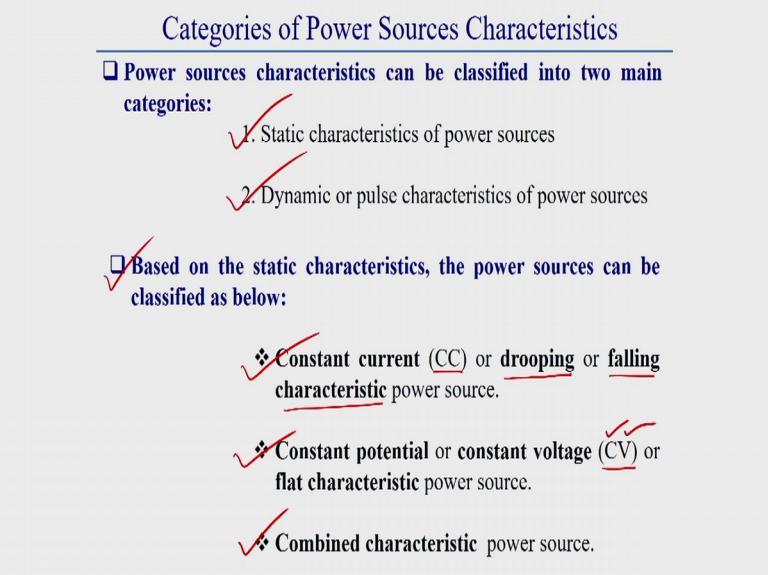

Actually power source characteristics can be classified into two different categories; one is a static characteristics of power sources and another one is dynamic characteristics. Now today's lecture I will discuss in details about a static characteristics and dynamic characteristics of power sources. First of all I will discuss about a static characteristics of power sources; static characteristics means here the variation; that means, it is the variation of load in a once we do the welding then whatever the output we are getting that variation is not rapid; that means, variation is generally is not almost there that

means the variation does not depends on time. So, that is generally called a static variation it is not time dependent output.

A dynamic or pulse characteristics means here generally the variation or output is depends on time which is a transient where there is a transient variation. So, first of all I will discuss in detail about a static characteristics of power sources; here generally here generally based on this static characteristic power source generally this power source is categorized into three different categories; one is called constant current characteristics that is represented in terms of CC; C for constant and another C for current this is sometime called drooping characteristics of power source and this is also sometimes called falling characteristics of power source the all the name has same characteristics actual though it has different name.

But this characteristics is same; that means, this characteristic had different different name three different name. Another categories is constant potential or constant voltage characteristics this is generally popularly known as CV characteristic power sources; that means, CV means here generally C is stand for constant and V is stand for voltage that is why this is also called constant voltage power source characteristics. Depending upon this characteristics this power source is categorize in that is called CV power sources and third categories which has a combination of CC and CV; that means, combined characteristic power source this third categories power source is called combined categories power sources.

Now, I will discuss in details about all those characteristics of power sources what are the different static characteristics of the power source that I will discuss in details. Now before going to detail discussion about constant current, constant voltage and combine characteristic power sources first of low first of all here we should know the arc characteristics.

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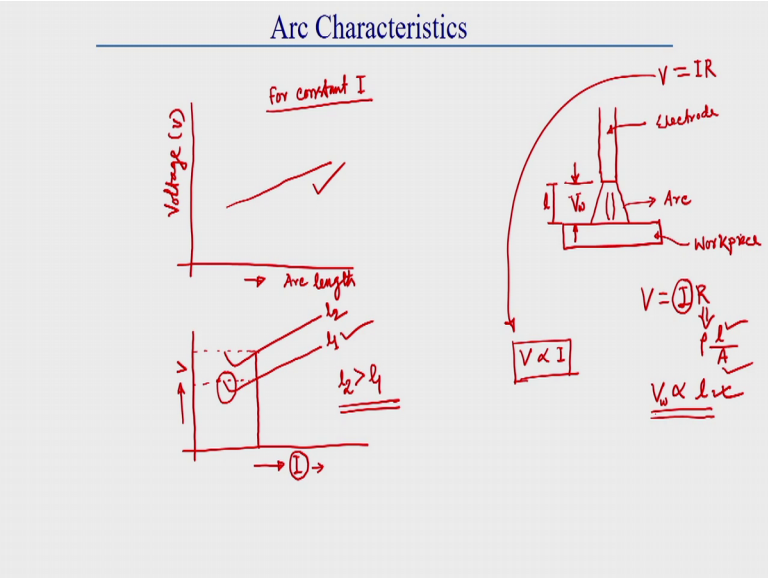

What is the characteristics of a arc? Generally arc means once we go for doing welding then generally in between the gap there is generally developed a arc this is generally called arc. So, what is the; what is the characteristics of arc? Which is very much important before going to detail about characteristics of power source. So, these arc means here in between this work piece an electrode this is actually electrode and this is actually work piece.

Work piece generally a arc is generated this generally the welding voltage is called whatever the voltage available in this arc gap; that means, in this region in between electrode and work piece whatever the voltage we got that is called welding voltage. Generally this voltage generally depends on its arc length of the arc. So, this voltage generally depends on thus length of the arc how its dependent? Let little bit I am just we know that V required to voltage is equal to I into R.

So, voltage is equal to I in to R; I is the current and R is the resistance, this V is equal to IR this resistance generally. So, voltage if the current is constant; if the current is constant generally this resistance is depends on rho l by cross sectional area; that means, generally this voltage depends on length and its cross sectional area. That means, this voltage is directly proportional to the length and its generally inversely proportional to the cross sectional area.

Now, if the all other parameter is constant the; that means, A cross sectional area of the arc then current then what happens this voltage is directly proportional to length of the arc. So, what we can get from here that if the length increase then generally this voltage increase in case of its welding voltage increase; that means, this V w is proportional to length of the arc here if other parameter is constant. So, here what we can get? If the length increase then its then voltage will increase from where we get this idea.

Now, what is the characteristics of this arc in a due to change of voltage, due to change of current that we should know. First of all we will see for a particular current how the voltage is changing if the arc length is changing let this is your arc length versus let this axis represent voltage V.

Now here it has observed that generally if the arc length change what I have already told you; that means, if the arc length change then for a particular current for constant current; that means, for constant current constant current I generally constant I generally this arc length if arc length increase then voltage increase. So, here generally this is generally thus its depends on; that means, is depends on arc length if the arc length increase then voltage increase.

Now, what is the arc length characteristics or arc characteristics? Once current changes; once current changes this is generally here we can represent the what is the characteristics of a arc in k in a voltage ampere diagram. Here what is observed that generally current is generally changing like this; that means, for a particular arc length let this is for a particular arc length l 1 voltage is increases with increase of current. From this curve we can see, but the at the initial position there is a variation there is a little bit decrease of voltage with increase of current why this is this I will discuss in details in case of in physics of welding.

Now here what we observed that generally after that generally it has observed that with increase of current voltage is increases from here also we get this relationship because V is also proportional to current; V is also proportional to current from this Ohm's law actually we can get this thing; that means, V is equal to I. So, V is proportional to I. Now we will see generally let this is for l 2. So, for different different arc length, different voltage we get. Generally in this case which one should have more voltage, which one

this which one should have more arc length whether l 1 is greater than l 2 or l 2 is greater than l 1?

Now, what we observe that voltage is also directly proportional to length of the arc. So, this is generally l 1 l 2 a length of arc. So, what we observe from here that if the. So, here what will be the things here generally the l 2 should greater than l 1. So, here as l 2 is more that is why for a particular current; for a particular current generally for a particular current its voltage magnitude also will be more for a particular current.

So, for a particular current if we change the arc length; if we change the arc length then voltage increase or decreases how its behave from here what behaviour we are getting? If the voltages if the current is increases first of all if the arc length is increases then generally voltage is increases for a particular current and another thing also we observed that for a particular arc length this voltages increases with increase of current that character this is very much essential once we go for decreasing the characteristics of welding power sources.

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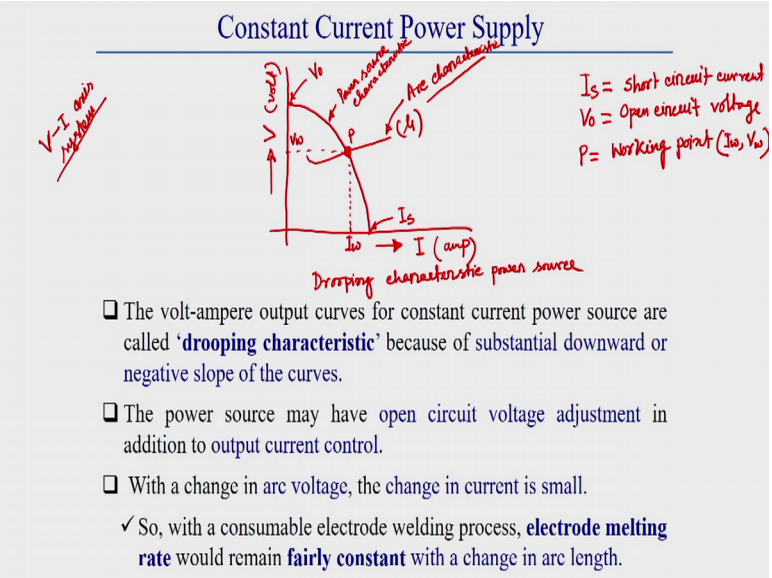

Now, we will go one by one about this is static power sources characteristics in details. So, first of all we will see, what is constant current, power supply characteristics? Generally constant current power supply characteristics curve, we can represented in terms of generally all the characteristics curve is represented in V I axis system V I axis system; that means, voltage ampere axis system generally, all the character generally

voltage ampere axis system, generally is used for representing the characteristics of power sources. Here, this horizontal axis represent the current, which is in ampere and this axis represent vertical axis represent the voltage, which generally in volt.

Generally, this constant current power supply characteristics curve; that means, if the curve is represented in this V I plot, then that is generally called the characteristic curve. Now, here generally in case of constant characteristic power supply, generally voltage ampere relationship can be represented by like this.

So, it is here generally here generally a substantial download or negative slope is there, what we can observe here? Here, generally if you draw tangent; if you draw tangent so, here what we got? Here generally this slope generally this slope has just, this slope have generally negative sign; that means, here change of slope is negative. That is why this power sources also sometime, because if we draw a tangent in this curve everywhere, this slope is becoming negative in nature.

So, this is a due to this substance substantial downward characteristics curve, this is also sometimes called negative slope curve or this is this characteristics curves known as drooping characteristic curve. Because, here generally substantial downward or negative slope of the curve is there, that is why these types of power source curve is also called generally drooping characteristic power source. This types of power source also called as drooping characteristics power source do drooping characteristic this types of power source also called drooping, because due to it is substantial downward or negative slope in this curve is there.

Now, this curve have some interesting point. Generally in this point this is called generally I s, this point is represent I s; that means, when the voltage is 0, then whatever the current is there, that is called generally I s. Here, I s is generally represented as short circuit current; short circuit current. And this when this current is 0 then; that means, when there is no load in the output terminal, then what about the voltage is coming that generally voltage is called open circuit voltage.

So, this V 0 is called open circuit voltage. Now, generally let us for a particular for a particular arc length, let us for a particular arc length, we know this arc length characteristic curves is look like this. In a V I space in a voltage ampere; that means, voltage current space, generally the arc length characters arc characteristics generally I

have already explained, arc characteristics can be represented as like this; this is generally arc characteristic curve.

Now, for a particular arc length generally arc characteristic curve is represented like this. Now, the cutting point of this characteristic curve of power supply, an arc characteristic curve this point known as working point, this point P is known as; P is known as working point. What does it means? Working point means; working point means, what about the current; what about the current and voltage let this is V w and this let this is I w. Whatever the current and voltage we are getting this is the actually this crossing point represent the welding voltage and welding current; that means, during welding what will be the current is there in arc. And what will be the; what will be the voltage is there in arc; that means, whatever the welding voltage is there that represent the crossing point of arc characteristic curves and power source characteristic curve.

This is generally called power source characteristic curve, this is power source characteristic curve; power source characteristic curve; power source characteristic curve, this is generally called power source characteristics and this is generally call arc characteristic curve.

So, this crossing point is call working point. Here generally represent the working voltage; that means, welding voltage and welding current. Here point should be I w first of all horizontal axis, then vertical axis. Here, one things we keep it in mind; that means, here for remembering purpose. Generally characteristic curves the vertical axis is voltage, which is started by V and in vertical term also in vertical orders in vertical word also there first term is V.

So, what will be the vertical axis; that means, its vertical axis should be generally vertical axis. So, for remembering purpose you can keep vertical axis should have V and also voltage is also started by V (Refer Time: 17:49). So, generally in a vertical axis generally here how we can remember this thing vertical axis for a characteristic curve, vertical axis should have generally voltage V, that way we can remember this thing.

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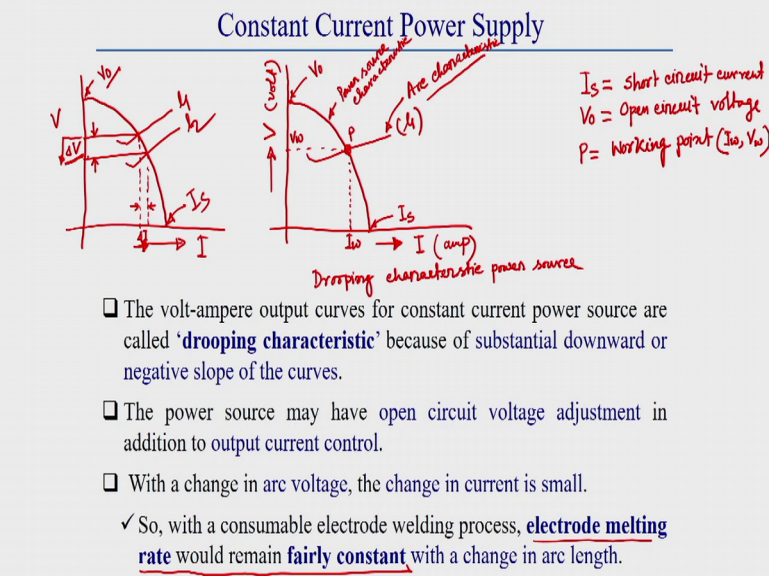

Now, here why this is called constant current power source characteristic curve? We should know this thing. Why this is called constant current characteristics power source curve? Because here one things we can observe from here, one things we can observe from here; that means, this is current and this is voltage. One things we can observe from here from this characteristics of one things we can observe, that with a small variation of arc length or arc voltage with a small variation of voltage. Here generally variation of current is very small; that means, here variation of current is delta I, let this is delta I. So, this delta I and let this is your this is delta V.

So, what happens here what we can observe that which is a variation of voltage, the change of current is almost constant; that means, the change of current is very small that is why generally this characteristics curve is called constant current power source characteristics. Now, this power source may have open circuit voltage adjustment. Here generally this whatever the open circuit voltage this power source generally open circuit voltage adjustment, as well as this current adjustment is generally this power source may have open circuit voltage adjustment, in addition to open current control also there. In the here we can call adjust this open circuit voltage as well as generally a here generally output current control is possible in this power source.

Now, here another things is very important here. Here, generally as here within a change of voltage; with a change of voltage actually change of voltage means change of arc

length. What we can observe from here, because if other thing is constant here change of voltage means change of arc length.

So, here if the change of arc length is occur or due to this if the change of voltage is occur, then what happens as the current change is very small; that means, current change is marginal, that is why what we can say here generally the power is remain almost constant. If some arc length change or voltage change is occur. Due to these generally here generally melting rate of melting of filler material, generally in this case is almost constant. Because, here generally change of voltage means let us this is a arc length and this is another arc length.

Now, what happens? So, if this voltage is reduce from here to here; if the voltage is reduce from here to here; that means, if this voltage is reduce from here to here, then here generally current is increase also a small. It is not more current will increase from here to here. So, here if voltage is reduced at from this due to this characteristics, if voltage is decrease, then current is increase, but the decrease decrement of this voltage magnitude and increment of this current magnitude is almost similar; that means, a small change of voltage a small change of current is occur.

So, here generally change of current is very small, that is why what I have due to change of voltage change of current is very small, that is why it is called constant current power source. And due to decrease of voltage as some sort of increase of current is there, a some sort of increase of current is there, that is why here generally power output remain almost constant.

So, that is why here generally electrode melting rate is fairly constant for this welding process. That is why here I have written here are electrode melting rate for this constant for power source, generally remains fairly constant with a change in arc length. Arc length means if the means change of voltage, arc length change means voltage will change. So, if this will change then there will be generally change of current will be marginal, that is why what happens here melting rate will be almost constant; that means, is fairly constant for this a power source.

Now, here one things we keep it in mind generally so, where is the application of this power source?

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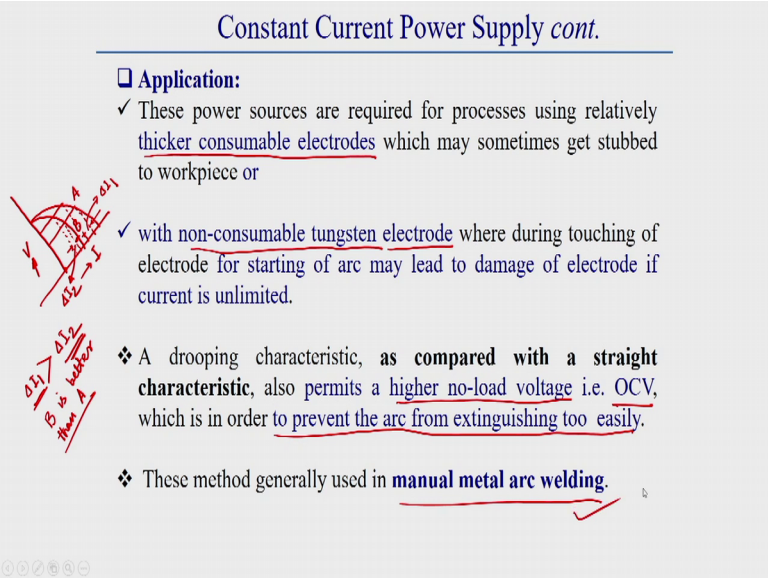

So, the these power source have generally application, especially where this power source are required for a process using relatively thicker consumable electrode, which may sometime gets get a start to workpiece. Or this power source characteristics we can apply where with the no consumable tungsten (Refer Time: 22:55) with non-consumable actual with non-consumable tungsten electrode, where during touching of electrode for a starting of the arc, may lead to damage of electrode if current is unlimited.

So, here what happens during touching of the electrode; during touching of the electrode especially for non-consumable types of tungsten tig welding, non-consumable tungsten electrode. During a starting of the arc here I am just showing little bit then it will be very clear to you generally this is V this is I voltage and this is I.

Now, what we observe here; what we can observe here; what we can observe here? Generally one things here we can observe here. Generally, during no load that means once it short circuited; that means, here what it what it is represent? Generally, here this is good for thicker consumable electrode. Why this is good for thicker consumable electrode. Because, thicker consumable electrode means if this thicker consumable electrode touch the work piece, then there is a chance of short circuiting.

So, due to this short circuiting there what are the things can happen, if due to this short circuiting generally this voltage drop, voltage reduce substantially; that means, voltage reduction is very high.

So, what happens due to this voltage reduction and due to this high conductivity, if it is shorted generally resistance reduce tremendously and voltage also generally in this case voltage also reduce tremendously. So, what happens if due to this voltage reduction, if the current shorts is occur, current rises occur tremendously, then there is a chances of work piece damage is there.

An another cases also so what happens here this is that is why this is applied in case of the power sources, the this constant current power supply generally have wide application, in case of thicker consumable electrode. In case of thicker consumable electrode what happens here, it may sometimes get a stuck to the work piece. So, if it get a stuck to the work piece, then this current rise will not be very high. That is why generally this power source have a use for thicker consumable electrode. As well as with non-consumable tungsten electrode, because non consumable tungsten electrode generally, in case of non-consumable tungsten electrode tungsten should not be melted or should not be degraded and it deposited to the work piece.

Because, if tungsten is deposited then this will create a defect this will be a inclusion. So, we should prevent this tungsten degradation. For that reason generally if we use these power source characteristics, then once we start the arc, then during starting the arc, by using tungsten electrode. Generally, if we touch the tungsten electrode to the work piece, then there will not be huge change of current. Because, if we use these types of power source, then due to this touching of electrode tungsten electrode to work piece here the current rise will not be very high.

So, for that reason here generally this degradation or melting of the tungsten electrode will not be there, that is why these types of power source is generally used for thicker consumable electrode and with non-consumable tungsten electrode power supply. If, we use this thing then generally for arc starting, we can reduce the damage of electrode if the current is not only if because, if we use this power source then we can reduce the chances of damage of the electrode.

Now, a drooping characteristics here another things you should keep it in mind I have not yet discuss about constant voltage power source characteristics. Because, generally here whatever the open circuit voltage use in case of constant current power source

characteristics, the open circuit voltage generally comparatively less in case of constant voltage power source characteristics.

Why this is required, generally this open circuit voltage as why this is required here, generally drooping characteristic as compared with state a straight characteristics also permit higher no load voltage or open circuit voltage, which is required because to prevent the arc from extinguish to easily. Because, if the open circuit voltage is more, than this arc has chances of arc extinguishing also will be less.

Generally, this method is widely used in manual metal arc welding. Manual metal arc welding why this method is a applicable more widely its use? Because, generally in case of manual arc welding, there is a chances of fluctuation of hand. So, if this fluctuation of hand will be there, then there will change the voltage, so if change the voltage then there will be change of current.

So, if we use these types of power source characteristic, then change of voltage corresponding to change of voltage here corresponding current change also will be marginal. So, here generally due to this vibration or shivering of hand, generally here, generally if the why if the hand is oscillating or vibrating, then this deposition rate will be fair more or less fairly constant. That is why, generally because here if we change the in case of that is why generally, this types of characteristics is used for manual metal arc welding process. Especially SMAW welding process generally this types of characteristics curve is widely used.

Now, here one things you should know, let us I am giving you some I am drawing some here one things let us I am drawing some curve let this is curve A this is curve B; 2 different characteristic power source I have drawn here. Now, what happens? Here, which one is good you should know this one? Here generally, in fast A case if due to change of voltage here we see, here due to change of voltage; here due to change of voltage, whatever the current change we are getting let delta I 1.

Where as in case of curve B; in case of curve B, this let us this change of current is let this change of current is delta I 2. So, if the slope is more steep, generally if this slope. So, here generally change of current due to curve A; that means, power source characteristics power source A, is greater than change of current due to characteristic curve B. So, here generally this; that means, as in case of curve B, it is less change by

changing same amount of voltage, as here less change of current is occur, that is why generally this curve B will give or B will provide us better control of melting rate compared to the curve A.

So, here generally B characteristics is better than A. Here, generally B power source is better than A. Why it is better? Because what happens in case of B generally we are getting by changing same voltage, generally here we can get a less change of current. Now, this constant current power supply generally widely used in case of manual metal arc welding process.

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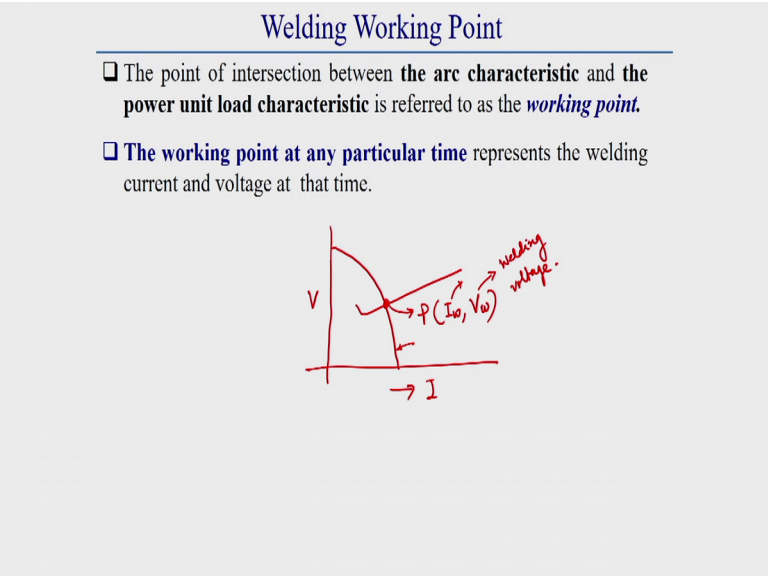

Now this working point already I have told you, because working point means, I have already discuss about working point. Working point means, the crossing point of power source characteristic curve and arc characteristic curve. So, this point is called generally working point. In this point whatever the current and whatever the voltage we got, this is called welding current and this is called welding current and this is called welding voltage at that time; that means, this crossing point of arc characteristic curve and power source characteristic curves is called is working point.

So, in the this point represent this crossing point represent their, whatever the welding current is used during that welding time and whatever the voltage is used during that welding time.

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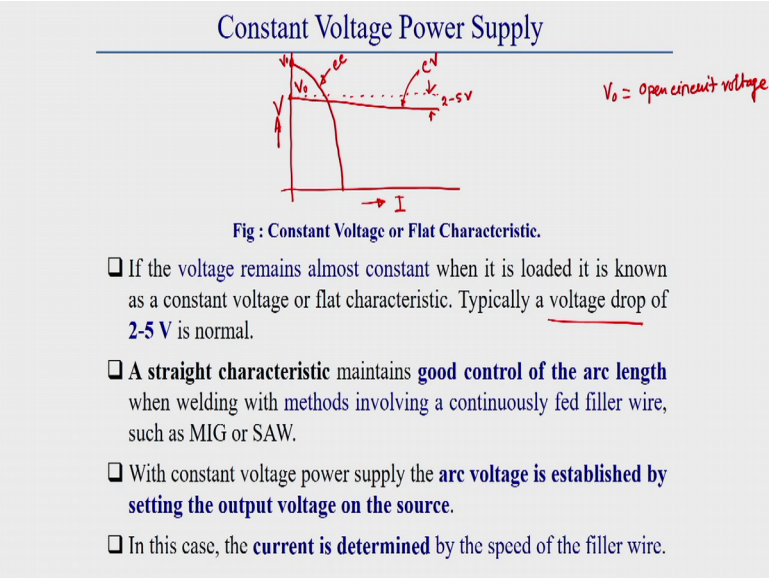

Now, we will go for constant voltage power source characteristics. Now, constant voltage power source characteristics here generally a voltage is remain almost constant; that means, which change of current, here generally voltage will be remain almost constant when it is loaded. Generally so, what we can say here? If the voltage remain almost constant when it is loaded, it is known as constant voltage or flat characteristics curve. Because, here the curve is representing by a almost horizontal line.

Generally, here typically a voltage drop we got is around 2 to 5 volt is normal. The within this length generally this voltage drop we got here. How the constant voltage or flat characteristic curve is look like that I am showing here. Generally, this is always I represent I told you, generally this vertical axis represent voltage V, an horizontal axis represent current.

Now, here generally this constant voltage power source characteristic curves is look like this. Generally, here the voltage drop; that means, here the maximum voltage drop here is around generally 2 to 5 volt, with the within this range. Why it is called voltage characteristic curve? Because here this characteristic line, this is generally voltage characteristic line, which is almost horizontal or where there is a small variation of voltage is there. Where generally voltage is almost remain constant that is why this is called generally constant voltage power source curve. This constant voltage power

source curve is repair generally term actually I have already told you, this is called C V power source characteristics also.

Now, here a very interesting things we will get, generally here first of all we represent what is this point represent V 0. So, here generally what is V 0 represent? V 0 represent here open circuit voltage; open circuit voltage. In case of constant current power sources what I have told you, these V 0 value constant current power supply its look like this, where V 0 is here. So, what I told that in case of constant current, this is generally constant current power source curve and this is generally constant voltage power source curve.

So, instead in case of constant current power source characteristic I told you this open circuit voltage generally is higher than this constant voltage power source curve. So, that is that you can observe from here also, that I have told you in constant voltage power constant current powers constant current characteristic power source.

Now, here why this state characteristics where it is applied, why, how it is look like what is the advantage, what is the drawback of this power source characteristic? That I should tell you now. Generally, this state characteristic maintain a good control of arc length; that means, here generally in constant current power source characteristic what we observe, 35.44 as there is a small variation; that means, a small decrease of belt is there will be a small increase of current or if there is there will be a small increase of voltage. Generally, there was what we observe there was generally a small increase of current was there.

So, they are generally changes of current and voltage was marginal, that is why what we observe there they are generally melting rate; that means, power in the arc was almost remain constant that is why they are generally melting rate was a fairly constant.

So, that is why in case of constant current what we told, that there is generally melting rate is constant, but in this constant voltage power source characteristics. Here, generally arc length remains almost constant. They here variation of arc length is negligible here; that means, a state characteristic maintain good control of arc length, when welding with a method involving a continuously feet filler wire.

Generally, this characteristic power source is used for automatic welding process, where there is a continuous feed of filler wire is there. So, if there is a continuous feed of filler wire, then what happens if there will be variation of if there will be any fluctuation and if there will be any variation of arc length? Generally, if we use these power source characteristics, then what happens this arc length remain almost constant; that means, there is a good control of arc length is there.

Why good control of arc length is there? If we use constant voltage power supply that, I will explain in detail. Now, with constant voltage power supply the arc voltage is establish generally this for constant voltage power supply here.

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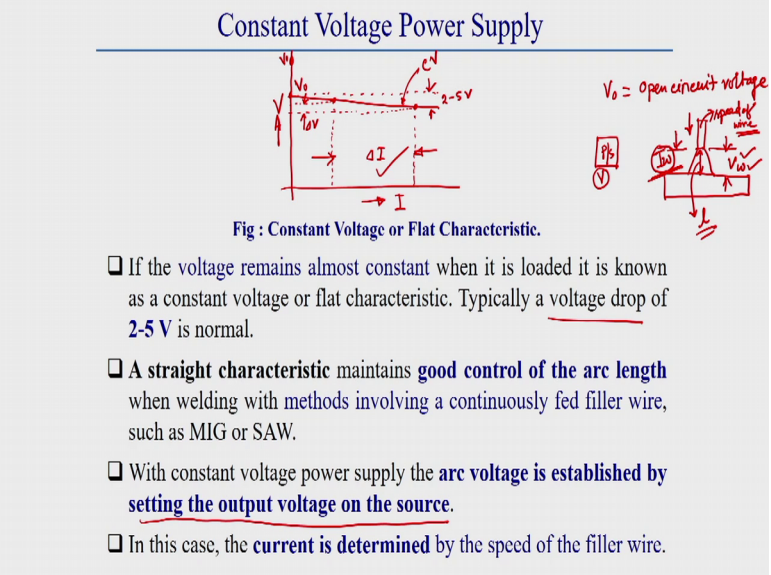

This arc voltage, whatever the voltage we are getting in arc these arc voltage; this arc voltage whatever the voltage we are getting in this arc, this voltage generally control by or these voltage generally established by setting the output voltage of the power source. That means, in power source itself, we generally this is that power source here generally we set the voltage, we set a voltage here by setting this voltage we can adjust this arc voltage. That is why here what is written; that means, with constant voltage power supply the arc voltage is established by setting the output voltage on the source.

Here, generally output voltage we can set by setting the voltage in power supplied cell. In this category power source, the current whatever the current will be during welding, whatever the current will be welding current. This current generally determined by the

speed of filler wire, this whatever the speed of; that means, how much speed is there a speed of wire?

So, this is speed of wire determined what should be the current here? So, if the speed will be more, then here generally automatically current will be more if the speed will be less, then current will be less. Because, if it is speed will be more then what happens here current will automatically generally control, because more melting will be required, because here generally this arc length.

Generally this arc length whatever the arc length is there, this arc length generally almost fairly a constant. Here generally almost we keep arc length generally fairly constant, that is why what happens if the means feeding will increase to maintain the constant arc length or to control the arc length, automatically or current will increase if or decrease.

So that is why in this current generally this welding current is determined by speed of the filler wire. Now, how it is happened that I will explain in detail. Why it is called constant current power constant voltage power source that also I will explain in detail in subsequent slide. Here one things we can observe that, here generally in case of constant voltage power supply, what we can observe with a small variation; with a small variation of voltage that delta V, here what we got? We got a delta V we got a huge variation of voltage here generally change of current is high very high.

So, that is why if here generally, if there are generally due to if the if here a small variation of feeding rate is occur, then this current generally automatically rise in such a way. So, that more metal will melted and it is regain to its original arc length.

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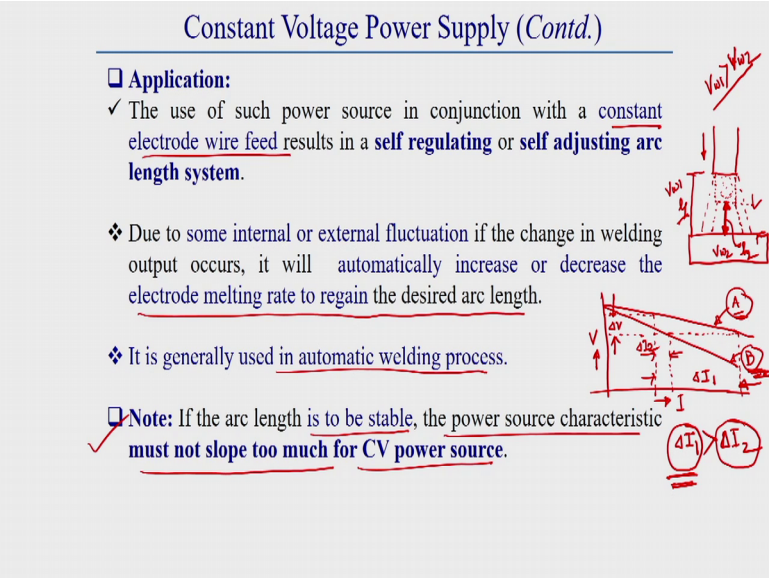

Now, for these characteristics; that means, for this characteristics this constant voltage power supply characters for power supply have some a special name. What is this a special name, that I will tell. Now, you see here one things you can observe, the application of this power supply, generally used where there is a constant feed of filler wire is there. That means, especially this is used for automatic types of welding.

Previous case constant current we used in case of manual metal, but this power source characteristics, we you generally we use, in case of automatic types of wire automatic types of filler wire control or we can say this is generally automatic welding process generally this power source characteristics is use.

The use of such power source in conjunction with constant electrode filler wire feed result in a self-regulating or self-adjusting arc length system. Actually, due to this characteristics of power source and it has a generally control of arc length is there or here generally we can keep our feed rate constant, that is why what happens how it is happen? That I will tell in details in subsequent slides.

Here generally why this constant electrode wire feed is there for this power supply is achieved, for this types of characteristic power supply is achieved, these characteristics is called self-regulating or self-adjustment arc length system. What is self-regulation and self-adjusting arc length system? This power supply why it is call self-regulating power

source characteristics, or why it is called self-adjustment arc length power source characteristics? That I will explain clearly in subsequent slide.

First of all due to some internal or external fluctuation, if change in welding output is occur, then it will automatically increase or decrease the electrode melting rate and to regain the desired arc length. That is why it is generally used in automatic welding process, what I have already told you. Here one things we should keep it in mind, if the arc length is to be a stable more stable the power source characteristic must not slope too much for constant voltage power source.

Why this is? Here one things you keep it in mind, why this is written? Here, you see what does it means in this last statement; that means, here arc length to be stable; that means, this arc length remain constant, what is this last statement tell the arc length to be in constant length?

Generally here, generally here what are the thing require this is generally current and this is generally voltage. What, I have told you, if the arc length is to be a stable the power source characteristic must not slope too much for constant, voltage power source what does it means.

Here one things we can observe let us a power source characteristic which have a slope like this, another have a slope like this. Now, for this case for this 2 case what you can observe, you can easily see from here. Let this is a for a particular power source A and this power source is for B. Now, which have 2 different slope characteristics are there.

Now, here what are the things we say a small changes with same change of voltage here. In first categories; in first categories generally current change you get let us, current change let us you gets delta I 1. Where as in second categories, if the slope is more steep then here this current change is let delta I 2. So, here generally delta I 1 is more than delta I 2.

So, from here what you can observe, if the slope is more, which is observe in case of power source B, in case of power source B. In this case here generally we get change of current is a small, where as if the slope is less in this case this current is current changes very high, they are comparatively high, generally current change is high. So, if the current changes high, then what happens here generally this arc length; that means, if

here just I am just showing little bit, then it will be more clearly this is a electrode; this is a electrode.

Now, let us this is the wire feeding, let us wire is continuously feeding here. Now, let us suddenly due to some internal or external disturbance, let us this wire feed rate increase this let us this wire feed rate increase.

So, in this case our arc length will become let us initially this arc length was l 1. Here, let us arc length is l 2. So, what happens in the first category this; that means, if this arc length change to l 2; that means, if arc length reduce means your voltage here whatever the voltage will be there V w 1, whatever the voltage here will be V w 2, here generally in case of V w 1 is greater than V w 2, why because from here we can observe that generally arc this arc voltage depends on arc length.

As l 2 is a small that is why what happens l 2 is a small. So, what happens here generally a l 1 is l 2 is a smaller than l 1. So, generally in case of l 2, whatever the voltage here will get, this voltage will be generally less than this voltage whatever we will get for arc length l 1.

So, due to this voltage changes, what we observe from here. If, this voltage changes occur, if the power source have a less negative slope or if the power source have a less slope, then generally this in case of shorter arc, here one things you can observe from here. If, here we use curve A, instead of curve B, then what happens here generally more current change will occur.

So, if more current change will occur means more melting, more power will be here and what happens, this mass of extra electrode will melt faster, than whatever the things happen in case of curve B. That means, here so, if the slope is less then chances of resizes arc length is rapid if the slope is less generally.

So, from here what we can conclude, the if the slope is less in a power source; that means, in the constant voltage power source if the slope is less, then what happens here generally change of current will be more. So, change of current will more means what happens more rapid melting of filler material will be there. So, more rapidly it can regain to it its original position. So, here generally if the slope is less as the delta 1 is a small delta 1 is more, as the delta 1 is more, for that reason melting will be more and it can

regain to its original arc length faster than the power source B, from there we can easily got.

So, here generally which power source is good here which power source arc length is stable here? Here power source one which have generally less slope than power source B. So, power source one have more stable arc length the then the power source B, this is a very interesting things we should know. So, lesser stable lesser slope power source constant voltage power source characteristics is better than, higher slope a constant voltage power source characteristic why, because generally lesser has higher change of current. So, higher melting regain to its original length.

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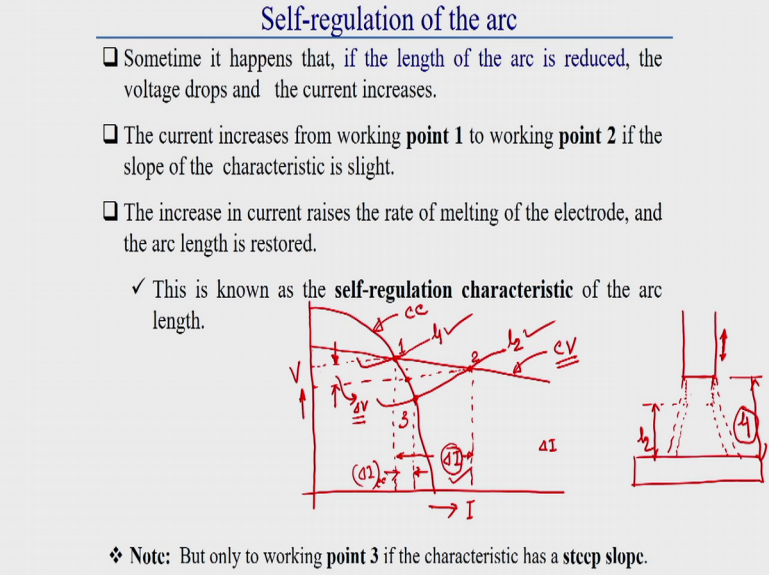

Now, this constant voltage power source characteristics also is called self-regulation of arc characteristic. Why it is called self-regulation of power self-regulation of arc characteristic that we should know. Why it is called self-regulation of arc characteristics? Because I have already explain; that means, due to a small change of voltage. Here, I am explaining again, in case of constant voltage power source characteristic what we observe, in case of constant why what we observe just here I will explain little bit in clearly then it will be very clear to you.

Let this is constant voltage power source characteristic curve and this is constant current power source characteristic curve. What happens? Let us this point is 1, this is point 2

and this is point 3. So, what happens let us this point was when there was a arc length l 1 and this point 2. So, let us this is point 1, this is point another arc length is let this.

So, let this is point 1, this is point 2 and this is point 3; that means, let this is arc this is initial working point and the let this is for arc length l 1, initial working point was 1, let this is l 2, where working point is 2. What does it means here actually I should explain why it is called self-regulation of arc; that means, let us this is a electrode initially it has a arc length, let us initially it has a arc length l 1.

Let us it has a initially arc length l 1, by some internal or external disturbance let the feed rate; let the feed rate increase or decrease and what happens it has changes arc length from l 1 to l 2; that means, some arc length let us it reduce.

So, if the so, let us this is for l 1 curve l 1 characteristic curve and this is for l 2 characteristic curve, because here some sort of a voltage drop is taken place. So, you arc length is at arc length variation is taken place. Due to this arc length variation here what happens, there is occur a change of voltage. Due to this change of voltage, in case of constant voltage power source characteristics, in case of constant voltage curve power source characteristic what we got we got huge change of current; that means, from here to here; from here to here, this mass of change of current is occur. From here to here this much of change of current is occur.

Due to this current change; due to this current change, here generally more power will be there and more power will generally mail due to this high current, this extra electrode, generally this extra electrode portion will rapidly melt and it generally regain to its original position. Its generally regain to its generally regain to its original position due to this; due to this high change of current.

Now, so, what happens as so, once this high change of currents and more melting of the filler material and its regain to its original length, l 1 its regain to its original position l 1. So, here generally due to internal or external disturbance, if there is a chances of fluctuation of arc length is there. This arc length generally due to increase generally due to decrease of voltage there is occur increase of melting rate, why because due to increase of melting rate which generally resize its arc length to its original position l 1.

So, what happens if this arc length reduce and come here, then what happens here more melting will be taken place and its return back to its original arc length l 1, l 1. It is return back to its original arc l 1 due to what? D ue to this high change of current.

So, if the characteristic curve is constant voltage characteristic, but here if the characteristic curve is constant current, then due to this change of voltage here change of current is; here change of current is generally constant current here generally change of current is here the change of current is generally change of current is very small. So, what happens due to this change of arc length generally here, the arc this a working point will be point 3, but if it is a constant voltage power source, then generally this working point will shift from 2 to 1, where as if it is a constant current power source characteristic then working point will be point 3.

That means, in this case if the arc length decrease; that means, this arc length remain within that length only; that means, if it is decreased to l 2 in case of constant current the arc length will be l 2 whereas, in case of a constant voltage power source characteristic if the arc length decrease; that means, if the small amount of voltage decrease, then more current will be change and due to this more current change more melting of filler material will be taken place. Due to this more melting of filler material this arc length regain to its original length.

So, as here automatically melting rate is increasing by changing the high by changing the current ranges in higher level, that is why these types of characteristics power source or this constant voltage characteristics power source is called self-regulation characteristics of arc. So, here what we observe if the voltage reduce if in a constant voltage power source, if the voltage is reduce or arc length reduce, then what happens due to this a small reduction of voltage high increase of current is occur, due to this high increase of current.

Generally, what happens this more melting of filler material will be taken place, due to this more melting of filler material; generally its regain to its original arc length. That is why in case of constant voltage power source characteristic, generally this arc length remain almost same; due to this arc length control characteristic this is also name as self-regulating characteristics of arc.

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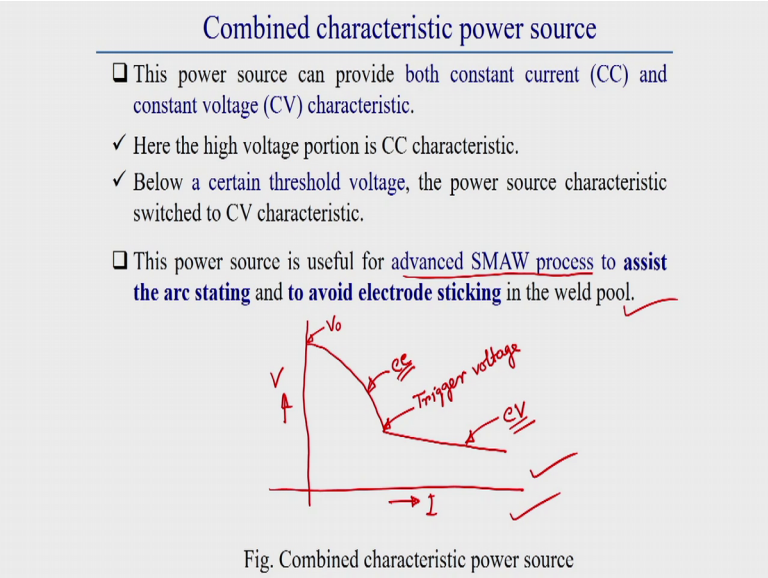

Fig. Combined characteristic power source

Now, another last categories of this static characteristics power source is called combine characteristic power source. This combined characteristics power source have a this combine characteristic power source consist both constant current and constant voltage characteristics. That means, here the generally higher voltage, this is generally open circuit voltage; open circuit voltage, generally this higher voltage, that here generally the higher voltage portion is constant current power source characteristics and lower voltage portion is constant voltage power source characteristics.

Generally, below a certain threshold voltage, this voltage is called triggered voltage, this voltage is also called triggered voltage, this voltage is also called triggered voltage. Generally, due to generally it has this higher voltage portion is constant current characteristics and lower voltage portion is constant voltage characteristic; that means, below a certain threshold value the power source characteristic switch to constant voltage characteristics.

These power source generally useful for advance Shielded Metal Arc Welding or is advance SMAW process, why because to assist the arc stating and to avoid electro district sticking in the weld pool. So, this generally power source characteristics power source characteristics have a application. In case of advanced types of SMAW process, if we use this types of power source characteristic, it will assist the arc stating and it will

avoid the electric sticking in the weld pool. So, this power source characteristics also popular for advanced types of SMAW process.

Now, next class I will discuss in details about dynamic characteristics power source and some other information on and some important other information on welding power source. So, next class sorry next class I will discuss in details about dynamic characteristics of power source. And where generally what is the advantage, where the where the generally this dynamic characteristics is important and some other fundamental knowledge on welding power source.

Especially, what should be the insulation type what should be the means wire type generally then what should be the feeding mechanism, we should use feeding mechanism generally we should use for power source let it to that things next class I will discuss in details. After that generally I will complete the power source categories and its characteristics and then is switch to another topics that is called physics and principle of welding process.