Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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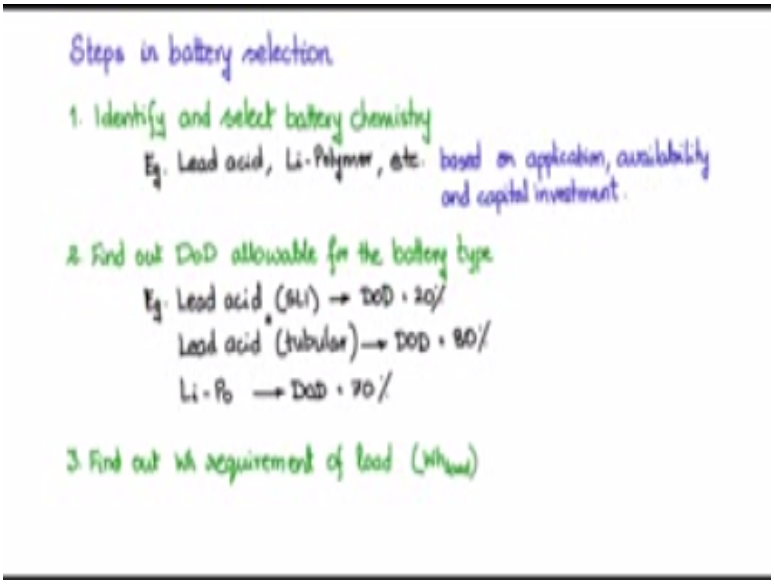

Let us now go through these steps for selecting the battery for a given application. 1st we need to identify and select battery chemistry for the given application. What it means? Is that do we need to select a lead acid battery or should we select lithium polymer battery or sodium sulphur battery extra? Now we need to make the decision based on the application, whether the application needs lithium polymer, lead acid, whether lead acid sufficient.

Whether the availability of that particular battery is easy or not and off course the amount of the capital available to invest on the battery, now these are concentration that you need to take and based on that you select a particular battery type, the battery chemistry. For most of the application especially if it is not on a mobile platform and if it is for, solar application where real estate is not an issue because any way you need real estate for the PV collectors.

One can start of by going with lead acid batteries because the capital investment will be lesser. Next find out what is the allowable depth of discharge for the particular battery. Now this is the important parameter that you should know because this tell you what is ampere rating capacitor of the battery that you will finally have to select. Now the depth of discharge also depends upon the chemistry and the type of the battery that you will be choosing.

The lead acid battery for example the SLI batteries start lighting ignition which are used for cars vehicles. They have very high power density requirement but the energy density is low, they have the depth of discharge of around 20% only. So you do not have selected this type of battery for continuous discharge, continuous low discharge current type of applications. Now if we take lead acid tubular battery it is good for continuous low discharge application. Here the depth of the discharge can go deep as 80%.

Lithium polymers batteries can go to 80% but normally 70% is set chosen. So when you w2nat to go for these deep discharge batteries your application also should equivalently dictate, such deep discharge batteries, if the discharge current are low but continuous for a very long time, then go for the discharge batteries. If the discharge currents are very high and short time then go for batteries like SLI batteries. Next find out whatever requirement of the load? We need to know this, whatever the load is in order to decide the capacity of the battery.

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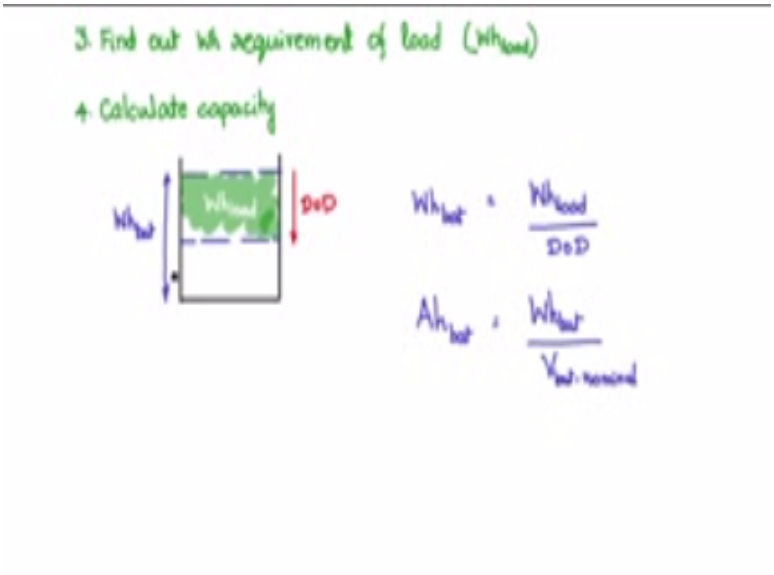

Next let us calculate the capacity of that is required, so that you may chose a battery of a particular ampere rating. Now if you take a battery like this and let us say that, the depth of the discharge that we have find out for that battery is round so much. This is the DOD of the battery then this shaded portion is the usable Wh_{load} or this is the Wh_{load} that can be given to load and this whole capacity is what you have to rate the battery for.

So Wh_{load} battery is Wh_{load} load/ DOD depth of discharge and Wh_{load} or rating of the battery would be Wh_{load} / by the battery voltage nominal battery voltage, so if you take for example lead acid battery containing 6 cells.

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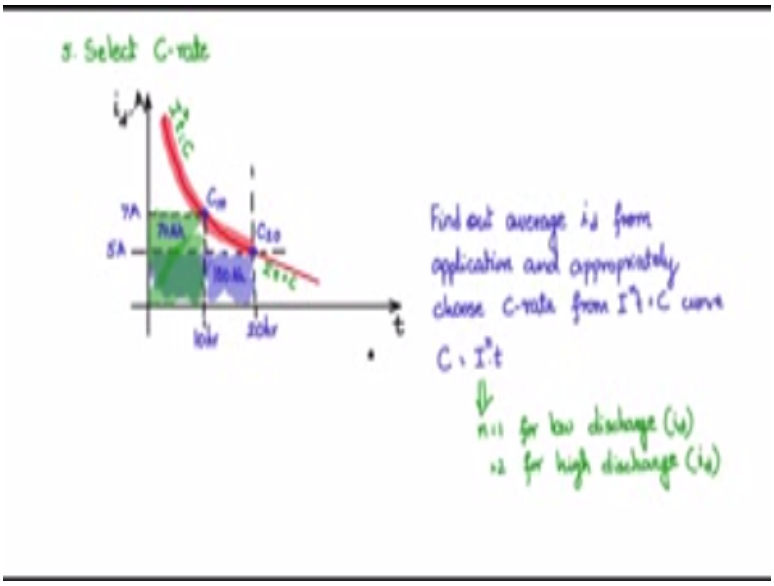

Next let us select the C rate for the battery. In order to select the c rate let us consider this graph on the x axis I have t the discharge time in hours and on the y axis the discharge current id enacts. Let me now mark an arbitrary operating point in this i_d vs t, I will take an arbitrary operating point like this, I will explain what that is, so this operating point is the intersection of some discharge current id here and some time in hours.

So this area here would be the amp powers and let us consider this points for now, let this point indicate a particular series. Now at the values of discharge current lower than this operating point, I have drawn a straight line here and it is following this relationship which is I x t = c and then here discharge current above this particular discharge current, it will follow some kind of square pattern.

Now that relationship is $i^2t = c$. now consider this operating point here, let me mark that, with respect to the operating point, all those area here, let me say is under amp powers, let say this area here is 100. Which means I can have let us say for example 5A this discharge current 5A and for this we have discharge time 20 hours, so for 20 hours we are 5A flowing resulting in 100A hours ask on to the load.

And we can say this is the C 20 rate battery operating in this fashion. Now let us say you want to choose somewhere here 10hour will you get still 100A capacity no you will get something lesser because now you are trying to discharge more current in lesser time. So let us say, I have

discharge time as 10hours and you have chosen a battery, now the discharge current here would be at approximately let us say 7A it is not going to 10 A.

So this area that is passed on to the load in case 70A hour, so this operating point now let us say at c10, so a battery a C20 battery, if the operator at C 10 the capacity is reduced 70A hour. So as you start going higher id discharge current, lesser and lesser time results and therefore the capacity also reduces it is not same as what you started of with the C20. So at low discharge currents you could have the model as a straight line it=c.

As the discharge current becomes higher then you have to use the square law pattern for the model $i^2 = c$. so you will have model power c rate choice something like this and then knowing the value of the discharge current, you can appropriately choose the C rate for the battery. So find out the average i_d depending upon what the application demands and what is important for the application and appropriately chose the c rate from the $i^n \times t = c$.

So this we can say $i^n \times t$ is = constant and that constant is representing the capacity. So n is a varying quantity, so we say n = 1f or low discharges id is low, so here we use n = 1, so at low discharge currents we have c= I x t simple amp power hours and for high discharges we use the square law n = 2, for high discharges currents id being high. So in this region you have $i^2t = c$ for the discharges current which are larger. So using this kind of approximate model you can select the c rate for the battery given discharge profiles.