Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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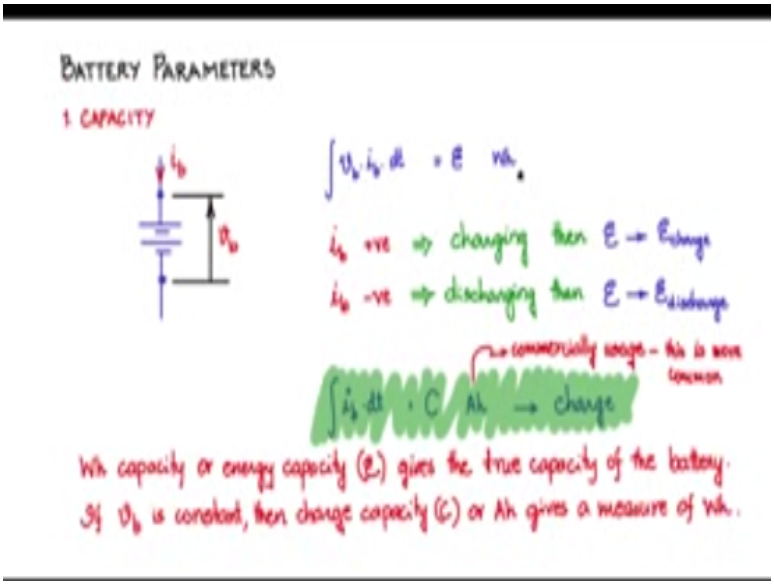

There are certain battery parameters that you should be aware of in order to select and specify for batteries one of the most important parameters is capacity of the battery what is capacity of the battery so let us consider this figure which gives you a picture of the battery symbol and these are the battery terminals let us say and then there is a current flowing into the battery positive terminal and that is called IB and let me mark the voltage across the terminals and we will name it as VB.

Now given such a battery with the terminal voltage Vb and the current flowing into the battery positive Ib which means is the charging current we can define the capacity the energy capacity in the following manner, so you have integral Vi Vb Iv dT this is nothing but energy in whatever is and Ib if it is positive Iv is positive means it is flowing into the positive terminal meaning it is charging the battery.

So this implies charging then the energy that you would calculate in this fashion would be the charging energy each art on the other hand if Ib is negative meaning Ib is flowing out of the positive terminal it is flowing in the reverse direction as indicated here then it implies that the battery is discharging then the energy is represent representing the discharge energy he discharged therefore when you say capacity of the battery it would mean the bat over capacity how much amount of energy that the battery can hold how much amount of energy the battery can discharge to the load.

So we talk in terms of what others however you can also talk of the capacity in terms of charge columbic charge integral of iVdT is nothing but you see and it is nothing but ampere hour and that hour is nothing but the charge so is the charge capacity so people use this definition also to indicate the capacity of the battery now that if you compare these two if I have Vb constant then you will get the ampere hour capacity.

So whatever capacity or the energy capacity is the true capacity of the battery it will give you the true capacity energy whatever capacity of the battery however if Vb is constant the Vb is maintained constant here then integral of iVdt C the ampere our capacity will be a direct measure of integral of Vib dt that is energy capacity then the charge capacity C or the ampere our capacity will give you a direct measure of the whatever of the battery in the commercial world this ampere our capacity as defined here integral of Ib. dT = C ampere volts unit.

Now this charge capacity is the one which is more popular and you will see that in almost all the battery specs and people using the edge of the battery the edge spec for the battery much more commonly than WH spec of the battery, so therefore when you look at battery data change the edge of the battery is a much more common battery capacity spic than WH so commercial usage terms this is much more commonly used.

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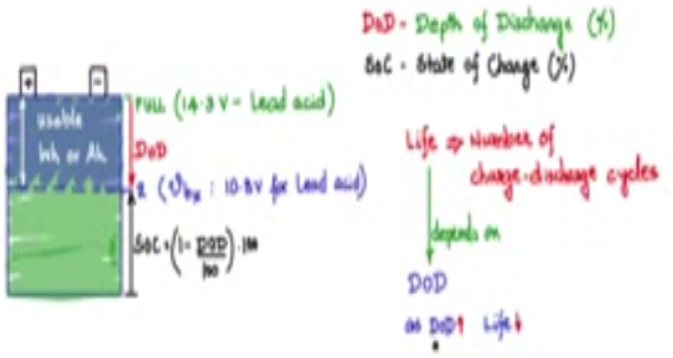

Consider the figure of the battery as shown here are the positive terminals negative terminal let us take the analogy of a water tank in case the water tank when you have the water tank full of water and say the tank is full likewise even in the case of the battery when it is fully charged say it is full and under full charge condition the open circuit voltage across the terminals will be maximum take for example in the case of a lead acid battery a cold volt let acid battery which you will find being used in cars and vehicles.

You will find that it is around fourteen point three volts not actually 12 volts but 14.3 volts under full charge condition now consider another level a level X now at this level the amount of charge available is much lesser than full tank and like in the case of the water tank once the water level has decreased to the level X the potential is also reduced same way here also at level X the voltage across the terminals of the battery is much lesser than the voltage that you would find across the terminals when the battery is full.

Suppose if the battery is discharged to the level X then the depth to which it has discharged is called DvD the depth of discharge so from 100% to X % so 100 - X % is called the depth of discharge depth from full, so it is called the depth of discharge and normally expressed as percentage and it is a very important specification parameter that you will see in battery specs and it has lot of influence on the life the battery we will discuss that shortly so when you see the battery has gone from full tank to this level X this much amount of charge as shown shaded here is the amount that has been utilized.

So this is the utilized charge and if you set X as the limit that you do not want the charge level in the battery to go below this because you would like to have minimum potential and maximum potential limits and if you do not want the potential across the terminals to go below a particular 11 so let us say you would decide on a lower limit of the charge level for the battery just like you define a lower limit or the water level for the water tank.

So then this shaded area would become the usable charge are the usable capacity of the battery so this level is corresponding to the useable whatever or ampere-hour of the battery DoD is measured from full to the level X just like you measure from 100% to the level X you can measure from 0% to the level X to get the state of charge so if I measure from 0 to level X as shown here then you call it a state of charge state of charge is nothing but 100% - DoD% and that is equal to 1 – DoD / 100 x 100 state of charge being expressed as percentage.

So DoD and state of charge are complementary state of charge will give you the amount of charge existing in the battery DoD depth of charge will give you the amount of charge or whatever that can be used up or has been used to supply to the load state-of-charge is also expressed in percent.

So at an arbitrary level X let us say the battery voltage is X VbX note that VbX will be less than the battery potential at full capacity or full charge, so as the charge decreases the battery terminal potential also decreases you can set a voltage below which you do not want the battery to discharge and that would be the limiting voltage or the fully discharged condition voltage as far as your application is concerned.

So for example the lead acid batteries 12 volt lead acid battery we will set it as 10.8 v as the discharged condition and we will not allow it to go beyond that below that, so the voltage range for a 12 v lead acid battery for most of the applications would be from 10.8 v minimum to 14. 3 v maximum connected with this capacity and depth of this charge is life of the battery life of the battery is expressed in terms of number of charged discharge cycles one of the significant parameters this life of the battery is dependent on is the DoD of the battery.

The depth of the charge of the battery so the life depends significantly on the depth of the charge as the depth of discharge increases the life decreases what it basically means is that if the depth of the charge is 20% you have some number of charge discharge cycles let us say 1000 charge

discharge cycles if the depth of the discharge goes down to 60%this goes down deeper that is you are going into deep discharge then the life would probably let us say come down to200 cycles instead of 1000.

So there is a kind of an exponential kind of decay in the life as the depth or depth of detail for the battery increases so DoD is an important parameter in determining the life of the battery