Elementary Electrochemistry
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Validation of Ostwald Dilution Law using Acetic Acid

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Welcome back to this demonstration of experiments for Elementary Electrochemistry course. And in the previous video, we have demonstrated the measurement of conductance of a series of HCl solutions starting with concentration N by 256 normal, N by 256 to up to N by 4, and as we discussed in the previous video, now I have prepared dilute solutions of acetic acid.

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So I have used this 1 normal acetic acid solution to prepare N by 2 acetic acid by half dilution, from this I have prepared the third solution N by 4; like that we have come up to N by 256 by half dilution method. So every time I have taken 50 ml of the solution and diluted it to 100 ml to make it half diluted.

So now I am going to use these dilute solutions from left to right which is the most dilute to most concentrated one by one as before which we have done for HCl, we will do the same with these acetic acid solutions and take the reading of conductance for all these solutions and then we will plot the equivalent conductance versus square root of concentration afterward. So let us start by taking the N by 256 solution.

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LABINDIA
pH/CON METER
Con= 98.62uS R6 C
K = 1.025 * 23.7°

I am going to use this N by 256 acetic acid solution to start with, and then slowly I will go ahead with more and more concentrated solutions. Since I had just water first time, I am just going to wipe water with tissue paper and remove the tiny trace and also dry this beaker with tissue paper to remove any trace of water which may then also further dilute the acetic acid which I am going to pour here.

So just pour acetic acid that much or the solution that much so that the electrode is completely dipped inside the water, and we will now note down the readings that we see here. So now with N by 256, the reading is 98.08 micro-siemens.

So what you see is this is much less than that we observed for HCL because acetic acid is a weak acid and it does not dissociate completely. So although the concentration of H plus is approximately the same in both, the acetic acid solution gives you a much less starting conductance compared to HCl.

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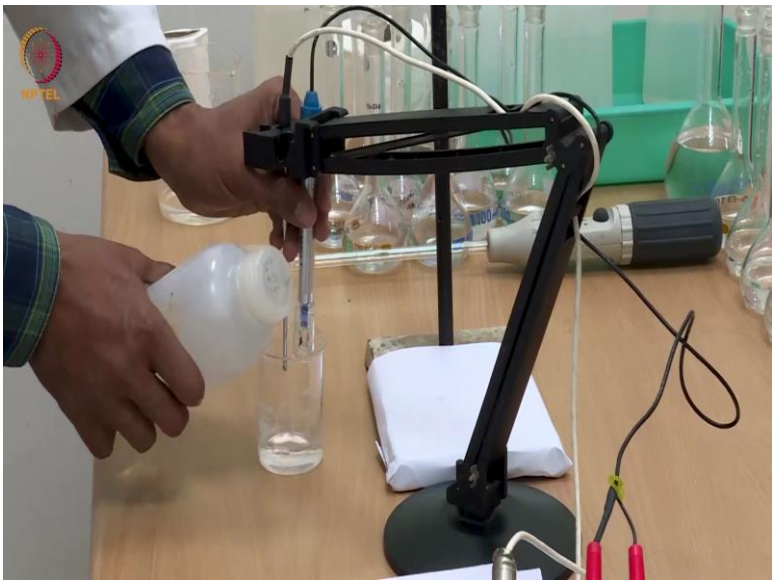

So we will now change this with the N by 128 that is double concentration. So we put it back. We need to wash the electrode once with water as before and we will then use the next solution and measure the conductance.

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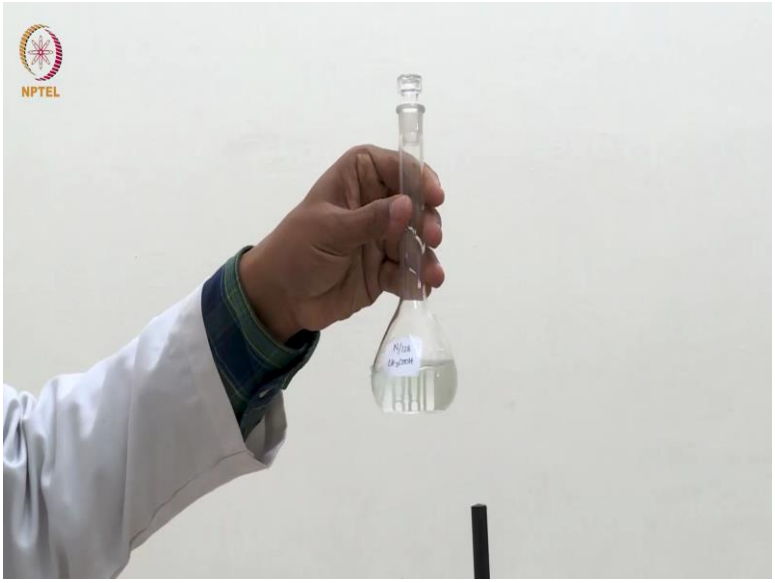

Now I am adding this N by 128 acetic acid to this beaker and we will measure the conductance. So it is 141.9 micro-siemens.

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Now I am going to use this N by 64 acetic acid and measure the conductance value. So with this N by 64 I am getting a reading of 204.2. Already you can notice that the increase in conductance with increase in concentration every time two times, the conductance is not increasing two times which was happening with HCl.

So you can understand the reason behind it. The degree of dissociation of acetic acid is dependent on the concentration and as a result the eventual conductance is different for increase in concentration by two times compared to HCl.

So when we plot we will be able to see the actual difference in these two set of experiments. We will show you that you will get a linear plot for equivalent conductance versus square

root of concentration in case of HCl and you will get a curve for acetic acid for the same set of concentrations.

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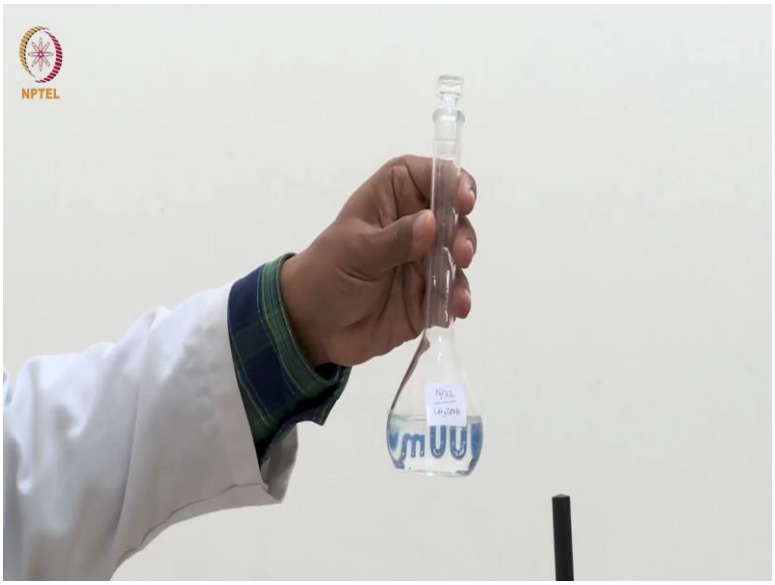

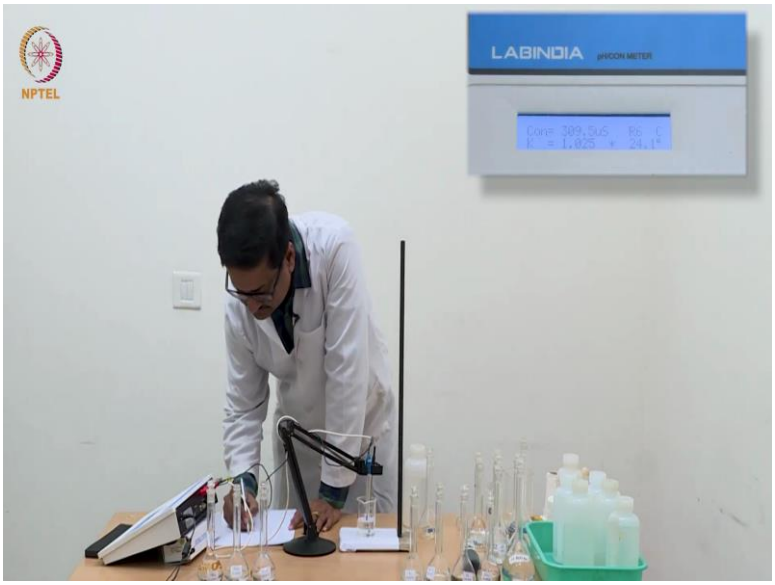

Now I am going to use this N by 32 acetic acid solution for conductance measurement. So now we have doubled the concentration from N by 64 to N by 32. The conductance has increased from 204 to about 310. It is now trying to stabilize around 309.7, 309.6.

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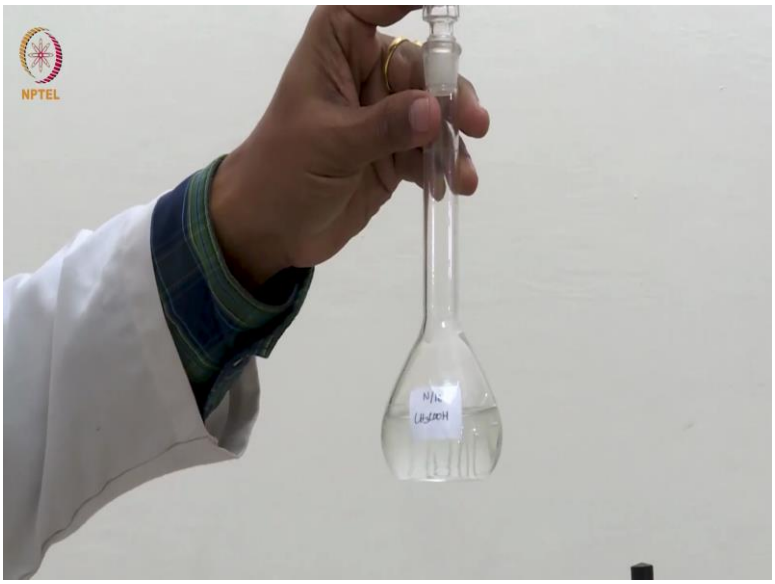

Now I will use this N by 16 acetic acid solution. I am taking this reading as 458.9. Remember that we are still in the micro-siemens range which you can see from this reading.

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This is the sixth solution with N by 8 concentration of acetic acid. So I am going to use this now. What we are seeing is that there is, the increase in concentration, with increase in concentration, there is increase in conductance but it is not doubling or it is not a regular curve, change concentration which indicates that it is not a linear change.

For HCL, if you look at the concentrations it was almost like every time you double the concentration, the conductance was becoming double which indicated a kind of linearity whereas in the case of acetic acid if you see the concentration that is changing double when I am are making the concentration double, the conductance is not becoming double. So that means it is not showing a linear behaviour. So when we calculate the lambda c values that is

equivalent conductance values, we will see a nonlinear behaviour. So now with N by 8, we have reached 687.8 micro-siemens.

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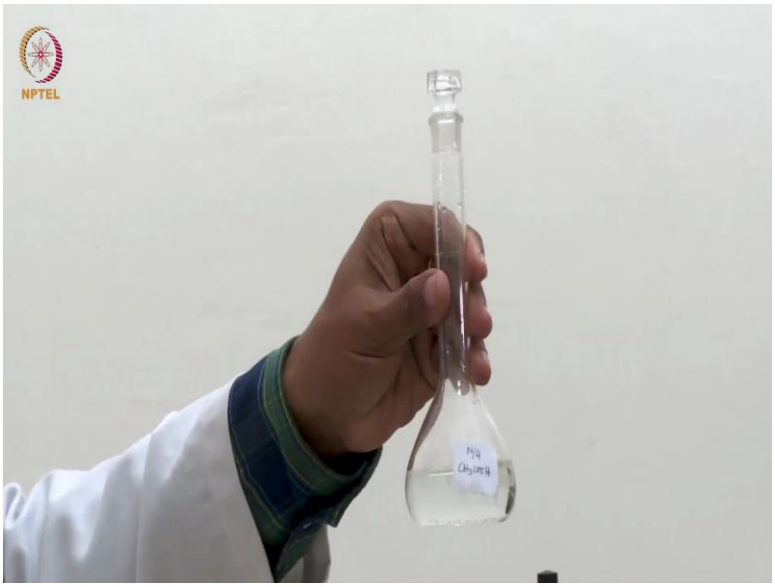

So now I am going to use this N by 4 acetic acid for my seventh reading and then we will end with N by 2 acetic acid. So now you will see the number has jumped to 932 and it is still increasing. We need to wait for a while for the meter to stabilize. Maybe 932.7, 932.7 is probably the reading, still increasing. So we take this as the reading, 952.2.

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Now I am going to use this last solution of acetic acid which is N by 2 acetic acid and with this, we will take the final reading and then go ahead and plot these, convert these conductance values to the equivalent conductance, and then we will plot the equivalent conductance versus the square root of concentration.

So now we will see that with N by 2 acetic acid solution, the conductance has reached its range in the milli-siemens region, and we see that it is about 1.375 that is 1376 micro-siemens, 1377. So maybe we should take that as our reading as 1377 micro-siemens.

So, with this, we end our experiment. I am going to plot these results using graph paper and show it to you in the next class. So before we close today, I must again remind you that when

you are using this kind of sophisticated instrument, we need to clean the electrode carefully after the use and make sure that the electrodes function as normal.

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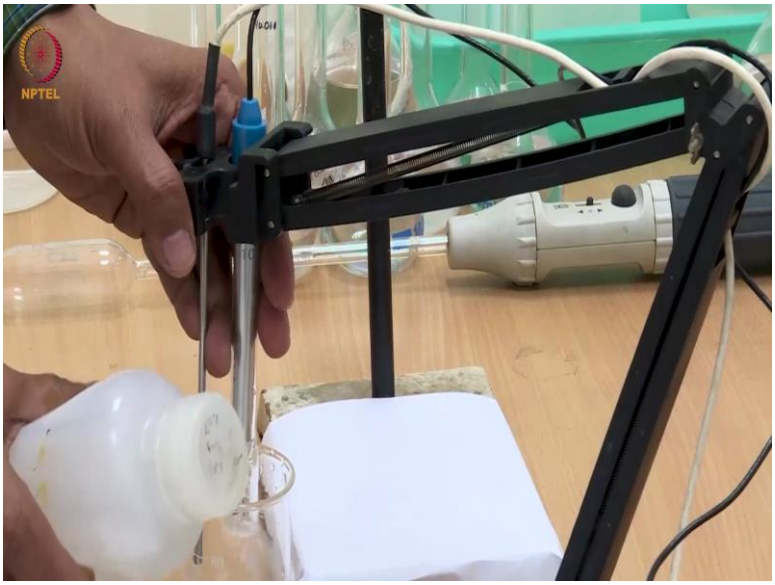

So we first wash it again with a lot of water and discard that water 2-3 times and then make sure that the conductance of water is read below 10 micro-siemens.

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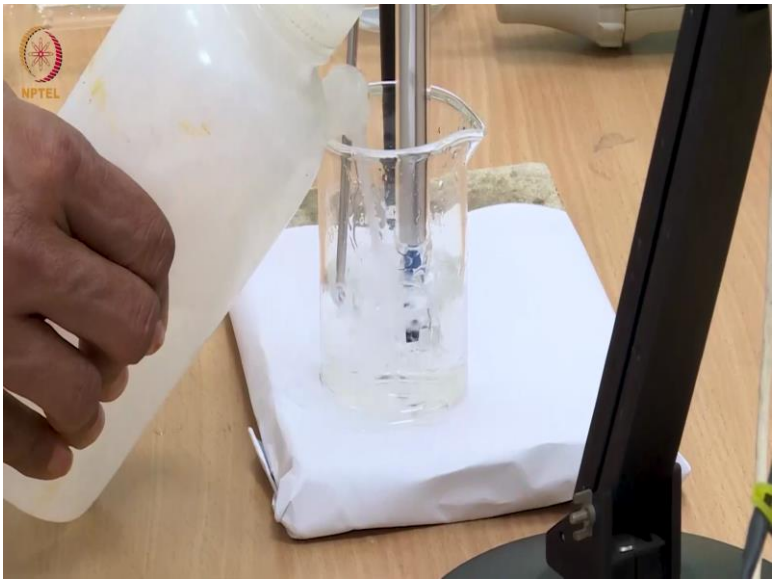

Now with distilled water, you can see that it is reading about 8-9 micro-siemens so that means the electrode is almost clean and one can use this electrode once again for any further experiment. So with this, I conclude this experiment and we will meet in the next class with the results and graphs of these experiments. Thank you.