Bioreactor Design and Analysis
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Lecture 10
Design of Fed Batch Bioreactors - Practice Problems - Part 1

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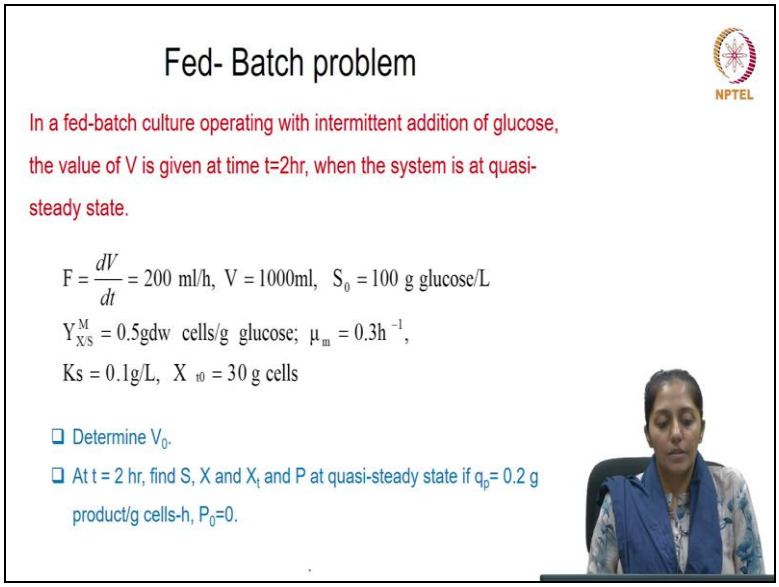

Let us do the problem the practice problem. So let us read the problem in a fat patch culture operating with intermittent addition of glucose the value of the volume at time t is equals to 2 hours is given as 1000 ml. At this time the system is running at quasi steady state. Now where the volumetric flow rate is given as 200 millilitre per hour. The feed concentration in this quasi steady state fed batch process is 100 grams glucose per liter.

The theoretical Y X by S is given to us maximum 0.5 the maximum specific growth rate of the culture is 0.3 hour inverse the Monod saturation constant is also given to us 0.1 grams per liter which indicates that the culture is following Monod's model. And the initial amount of cells when this fed batch at quasi steady state started was 30 grams. So let us see what is being asked? Let us take the first part determine the V 0.

So which means we need to determine what was the volume when the quasi steady state had started which means before 2 hours. So we know V is equals to V 0 plus Ft V is given to us we need to find out V 0, F is known and we have to find the t is given as 2 hours at which the

volume V is also known. So if you substitute all the values we will be able to find the value of V 0.

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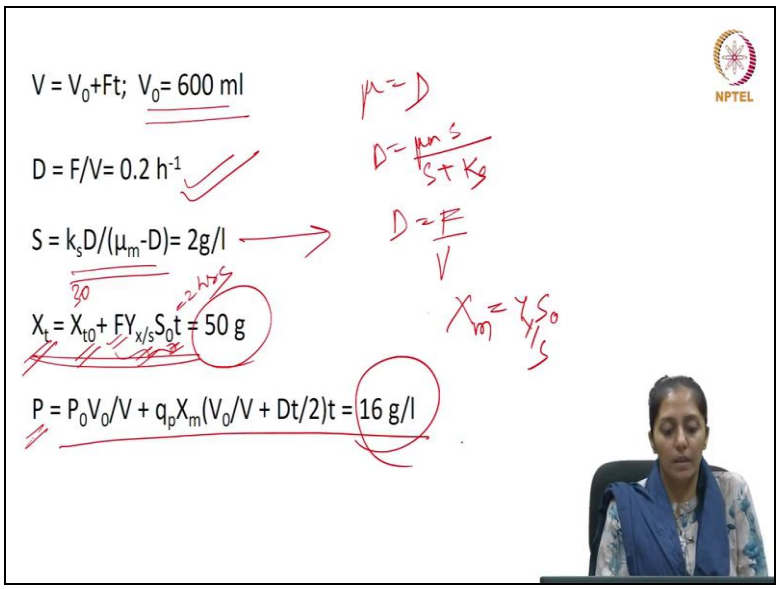

So your V 0 turns out to be 600 ml when the quasi state quasi steady state began. Now let us see the second part they are asking at 2 hours of the quasi-steady state we also need to determine the biomass concentration the substrate concentration and the amount of biomass at that time. The product also has to be determined given the value of specific product formation rate and the initial product concentration at t is equals to 0 which means at the start of the quasi steady state was 0.

So at quasi steady state we know mu is equals to D and we also know the culture is following Monod kinetics. So if you remember the rearrangement of the equation D is equals to mu m S upon S + K S. If we rearrange this we can determine the value of S in terms of the dilution rate mu m and K S given. So how to find the dilution rate the dilution rate is F by V. So volume at t is equals to 2 hours is 1000 ml F is 200.

So then we can find the dilution rate at 2 hours. So then if you substitute you get the biomass sorry the substrate concentration at after 2 hours of the quasi steady state. Now we also need to find out the amount of biomass and the concentration of the biomass. Concentration should be straight forward. Now the concentration of the biomass can be determined we know that they have given 30 grams of cell at X t 0 and we also know V 0 and we know it is quasi steady state.

So will the concentration of the biomass keep changing with time? No right. So the biomass concentration can be directly obtained from here as the amount of cells divided by the volume. So if you do this you will end up getting how much will it be let us see, 20 multiplied by 1000. So this turns out to be 50 grams per liter is X. Now we can even cross check this let us see.

We know at quasi steady state how the biomass amount will keep changing with time given the value of F, Y X by S and S 0. So S 0 is known to us Y X by S is also known, F is known and X t0 is also given. This is assuming that almost all the substrate which is coming in is getting utilized. So whatever is coming in once the quasi study state started is getting utilized. So this is the maximum biomass concentration.

So, which is given as Y X by S S 0, so now here if you remember this is how when we integrated equation one, we got equation 2. So I have directly used the equation 2 here to find the amount of biomass at 2 hours. So X t0 is given as 30 and if you will substitute all the values with t is equals to 2 hours here. Then your amount of biomass will come out to be 50 grams after 2 hours.

So if you remember the volume at 2 hours was 1000 is not it, 1000 ml so which means 1 liter so your concentration of biomass is 50 grams per liter. So which is the same as we had calculated earlier and the amount of biomass is 50 grams. Now they have also asked us to calculate the product concentration which as determined here.

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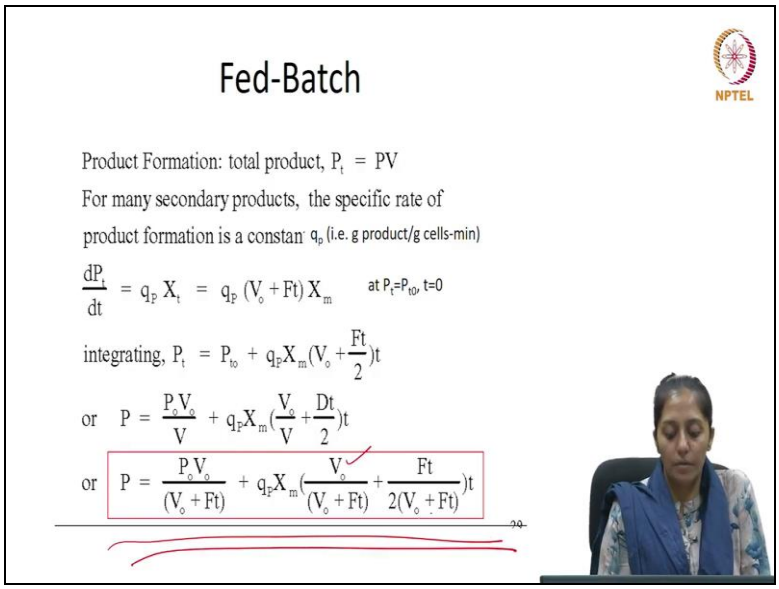

We know V 0 we know F we know t, q p has been given X m we have calculated as 50 grams per liter. So then we can find the value of product concentration which comes out to be 16 grams per liter. So I am expecting you people because it is pretty straight forward you will be able to find the right numerical value as shown here by substituting all the information which has been provided in the problem.