Hello students, welcome to today's E Learning session. We will have a look at the airlift fermenter.

The outline of today's session includes the definition of the airlift fermenter, the types of airlift fermenters, components, and working. The uses, advantages and limitations of the airlift fermenter. We will recap the session and have a look at the bibliography.

At the end of this session, the student will be able to define an airlift fermenter, to Explain the working of the types of airlift fermenters, to state the uses of the airlift fermenter and to highlight advantages and disadvantages.

How do you define an airlift fermenter? This is a continuous feed fermenter in which the circulation of the culture medium and aeration is achieved by injecting sterile air into the lower part of the fermenter.

So there is no mechanical agitation involved in an air lift fermenter. The air itself pushes the liquid inside the fermenter. There are two types of airlift fermenters. The first are what we call as the external airlift,and the other is the internal airlift. The external airlift consists of two vertical pipes which are interconnected at the top and the bottom. This allows for liquid to flow in a cyclic manner. The internal air lifts are again of two types. The draft loop and the split cylinder design.
The draft loop design is a tube in a tube design i.e. 2 concentric tubes. The inner cylinder is the ascending column. The outer cylinder is the descending column. In the split cylinder design an internal baffle or a plate is used to separate two regions of the fermenter, the two regions being the riser and the downcomer region.

Let us look at the components of an airlift fermenter. They are the Air riser region, the disengagement zone, the downcomer region, and the draft tube.

The Air riser region is a region in which the bubbles are sparged. Due to these bubbles in the riser region, the liquid is pushed in an upward direction because the bubbles are introduced with force, the air riser may be on the inside or on the outside of the draft tube. Risers on the outside of the draft tube provide better heat transfer efficiencies. The disengagement zone is a wider region at the top of the bioreactor. This wide area helps to stretch the bubbles in the foam and thus the bubbles burst. The disengagement zone thus prevents the carbon dioxide rich bubbles from descending into the downcomer region. The reduced bubble velocity will cause a reduction in the loss of medium due to aerosol formation. The wide area of the disengagement soon will also help to reduce the amount of foaming.
Disengagement zones add to the volume of the fermenter and they prevent the recirculation of the bubbles in the downcomer, so ideally the disengagement zone is the part where the bubbles break. The downcomer region is that part of the airlift fermenter where the liquid flows in the downward direction.
And this leads to liquid circulation and improved mixing efficiencies. The draft tube is the plate in the airlift which separates the riser region from the downcomer region. A draft tube helps in improving the mixing throughout the reactor. The mixing that happens in an air lift fermenter is an actual type of mixing that is a top to bottom flow of the liquid. This circulation also helps to reduce the foaming. This is a diagram of the

air lift fermenter. You see an internal airlift fermenter, here is the sparger through which the bubbles are introduced into the riser region. Because of the force of these bubbles, the air gets lifted up. It enters into the disengagement reason the bubbles break and the liquid comes down. This whole process gets repeated. This is an internal airlift fermenter. In an external air lift the bubbles rise up, they move and then they come down into the Downcomer region. This picture again shows you the movement of the liquid in the internal and the external airlift fermenter.

Let us see the working of the airlift fermenter. As we saw high pressure sterile air is introduced at the bottom of the riser. This Airstream will agitate, aerate and push the liquid through the Draft tube into the headspace of the bioreactor. The liquid then enters the disengagement zone. Here the pressure reduces, the bubbles break and the liquid then flows into the downcomer region. This entire process keeps on repeating.

What are the advantages of an airlift bioreactor? There is no impeller, hence there is very low shear and therefore airlift fermenters are used for growing plant tissue culture and mammalian cells.We have to remember that mammalian cells do not have a cell wall and hence they are easily broken with shear. The turbulence caused by fluid flow ensures good mixing of the liquid. The lack of the impeller shaft entering the fermenter also allows to maintain good stability within the airlift bioreactor.

The airlift bioreactor needs a lower energy for operation because there is no agitation device there. Easy to scale up. The height of the liquid causes enough pressure, which increases the oxygen solubility at the bottom of the vessel. Small bubbles will cause an increased surface area and a much better oxygen transfer rate.
There are disadvantages also to the airlift fermenter. There is excessive forming, very often this is broken in the disengagement zone. Cell damage due to bubble bursting, particularly with animal cell cultures, can also cause a problem.

Let us look at the users of the airlift fermenter. As we have seen, they are used to grow shear sensitive cells. For example, in animal cell culture of hybridoma cells for the production of monoclonal antibodies in single cell protein production. These fermenters avoid excess heat which is used in single cell protein production. There is excess of heat which is produced due to mechanical agitation.

Let us recap this lecture session. Can you list the components of the airlift fermenter? Can you describe the working of an airlift fermenter? What are the uses,advantages, and limitations of the airlift fermenter?

For further information please refer to these following books. Thank you.