INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

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NPTEL ONLINE CERTIFICATION COURSE

Unit Operations of Particulate Matter

Lec- 10
Continuous Filtration, Filtration Equipment (Part-01)

Dr. Shabina Khanam
Department of Chemical Engineering
Indian Institute of Technology Roorkee

Welcome the 5th lecture of week 2, where we are discussing different equipments used for filtration in industry. So if you remember the 4th lecture, there we have classified the cake filters and few equipment we have discussed over there, but we have only classified that, we have not discussed the operation of these equipment. Now here in this lecture we will discuss working of few filters which are used in the industry. The first one is plate and frame filter press.

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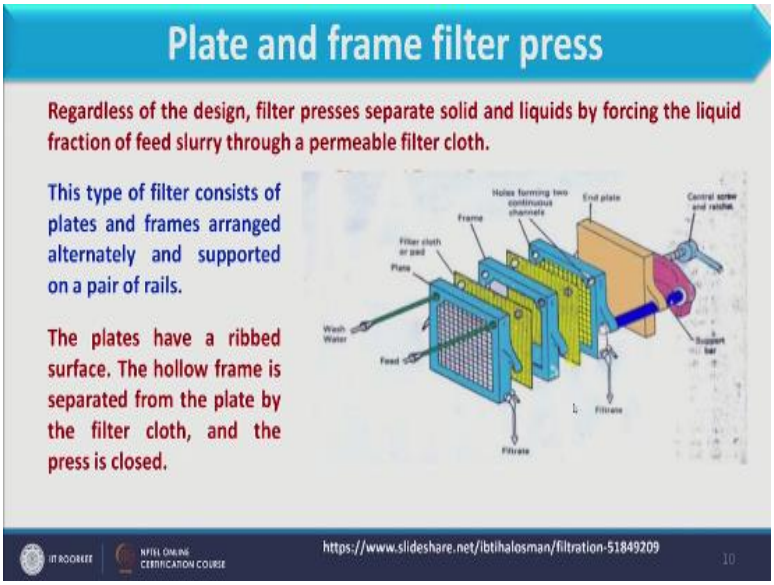

So regardless of the design filter press is separate solid and liquids by forcing the liquid fraction of the feed slurry through a permeable filter cloth. So here basically we use the filter cloth as a filter media and it blocks the solid on the filter media and let the filtrate penetrate through the media. So it separate basically solid and liquid for that purpose, for which purpose filtration is known.

So this type of filter consists of plates and frames arranged alternately and supported on a pair of rails. Now if you see this schematic what is shown over here, here this plate and frame filter press consist plates as well as frames. So what is plate and what is frame that we should understand. If you consider this figure this structure, the first plate we are showing over here this is known as the plate. And second here if you see this particular section it is shown as the frame.

So what is difference between plate and frame, in plate the complete section, complete plate is solid. It means we can consider the metal rectangle or metal square and that we can call as the plate. However, in frame only boundaries are made with the metal, in between the inner section of the frame is empty, only metal is available at its periphery. However, in plate complete plate is made of metal.

Now when we consider the plate, the inner section of plate which I have shown over here, this is basically grooved or this is not flat plate, but it has grooves and some, you can say non uniformity on the surface. And as frame is empty, in between two plates like if you see this figure here we have plate 1 and plate 2, and in between we have frame. So frame is always placed between plate 1 and plate 2.

And similarly after second plate we put the frame, then plate, then frame, then plate like this it is arranged in a series. And both side of the plate we put the filter cloth, so frame between frame and plate filter cloth is there. So here if you see this assembly this is plate, then filter cloth, then frame, then filter cloth, then plate, and similarly like other. All these are arranged in this supported bar and if you see this particular section here in plate nozzle are arranged and through this filtrate exits.

So if you see a feed enters from one side as the solid feed enters from one corner as plate is solid, it is metal throughout. So obviously feed will not enter into this, it will pass this plate and pass this filter media. However, when you see the frame it has hole over here and though it is empty in between whatever liquid is coming over here, or whatever liquid is coming over here it spread in this region, if you see it is spread in this region.

So once it is spread in this region it falls in this way and it falls in this way. So as both side of the frame is having filter media, once feed enters into this, the filtration takes place at both side of the frame. So this is the basic working of plate and frame filter press. Plates have as ribbed surface that we have already discussed, though hollow frame is separated from the plate by filter cloth and the press is closed.

So this is the complete assembly and how it is, how the filtration is carrying out that we have discussed. So once feed enters into this it comes through this filter media, the cake is deposited at inner part of this filter media and filtrate is collected through these plates. And similarly when we consider this particular section, feed enters over here, cake formation will be done at this surface through this filtrate penetrate and then we can collect filtrate from the plate section through these nozzles.

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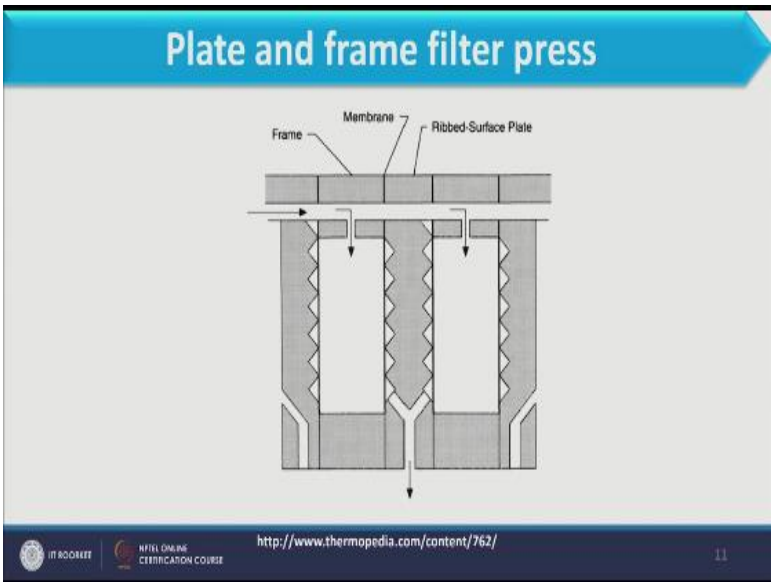

And here it is more clearly shown like, here if you see opening is already available in frame side not in plate side, because in plate it cannot enter. So liquid feed comes over here, here we have ribbed surface where cloth, filter cloth is there, so it spread in two section, first one goes over here and then goes over here, cake formation done at this surface as well as at this surface. And then filtrate which is passed through this, it is collected from these sections where nozzles are available, and through these nozzle we collect the filtrate. So this is the basic working of a plate and frame filter press.

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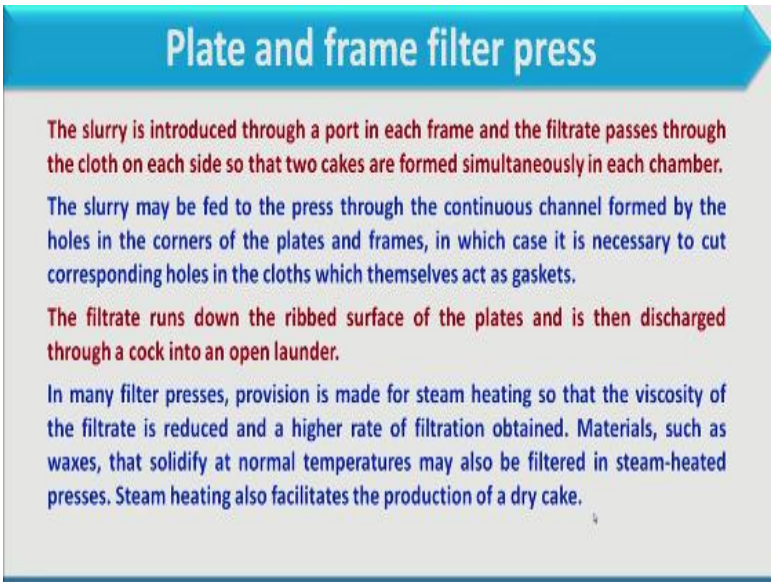

So if you see this slide here in this above three point it shows the basic principle which I have already explained to you. And further we should note that in many filter presses provision is made for steam heating, so that the viscosity of the filtrate is reduced and a higher rate of filtration obtained. Materials such as waxes that solidify at normal temperature may also be filtered in steam heated press.

So steam heating also facilitates the production of dry cake, so these are few factors about plate and frame filter press.

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Now if you see the slide, the first figure over here it shows the filter press of very large size and all these white section if you are seeing these are nothing but the cloth which is forming, which is falling in between in the plate if you see this section it is nothing but the cloth which is falling between the plate and the frames, so it looks like this very common pact and they are very efficient equipment ,now as far as the plate and then consider in this diagram you cans see the plate is basically in the metal it is formed in the metal however the frame is hollow.

So the basic feed enter over here the both side of the plate then feed over enters over here and the both side of the frame is covered with the filter media and through the filtration that has exposed already explained.

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And this is the type of the cake which is the deposited on the each filter cloth is available on the both side of the frame so here we have the cake formation on the both side of the flame occurs and her in this slide we will discuss in that one digits and in the plane filter.

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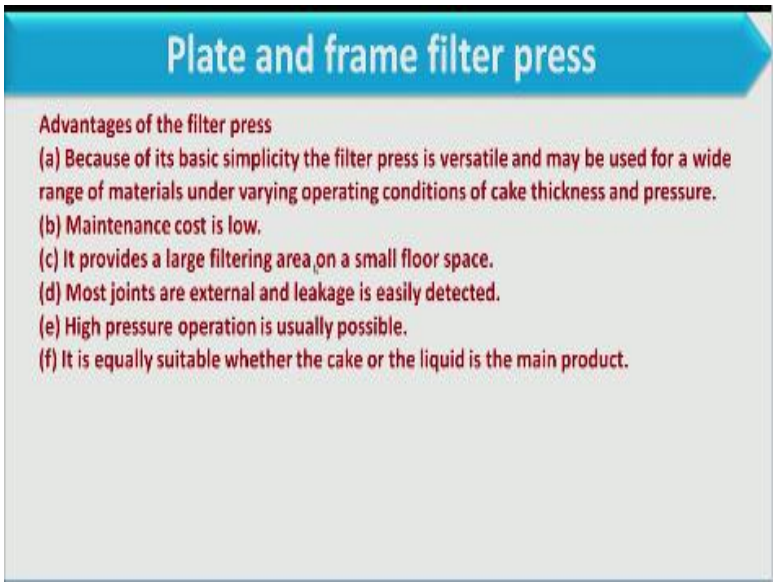

These are most commonly used in the filter pressed industry ,so the advantage of the filter press are because of its basic simplicity in the pressed in the made me used in the varying pressure ,so you can see the plate and then used the industry at very large scale another advantage is maintained cost is lo it provides large providing are in space I have shown you in the previous slide how large this is because the filter media in the frame and the plate are collected to the each other, so it look as compact.

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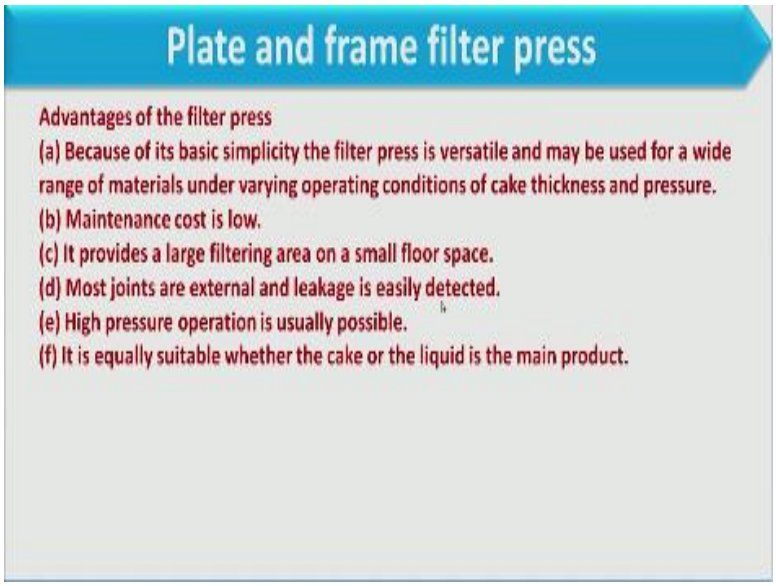

Most joints are external in this detected in the high pressure is usually possible it is equally to the table weather the cake is main product the solid is in that cake is more effectively. So the solid is the purpose that we can also obtain and that is because the complete in the structure the complete assembly the tightly pressed whatever cake we obtain this is the moisture. So that is the advantage of this .Now thus advantage of the filter press intermittent in the operation and continually dismantelyis showed batch.

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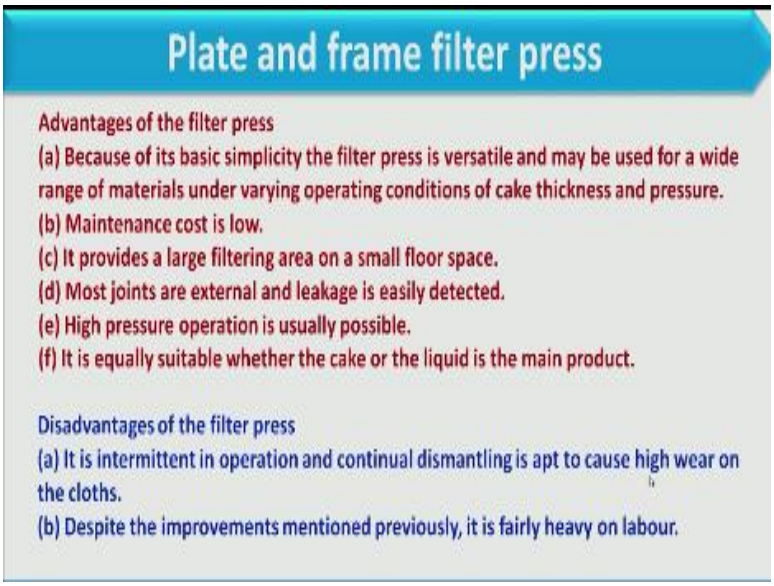

So because this filtration on the batch in the cycle in the dismantle thus the arrangement of the cloth and the frame will be carried out in the life will not be very large in the mention because in the dismantling clewing is required in this stress, now next filter we have in the pressure leaf filter if we see we have the image of this what happens in the leaf on that different leaves if you see in the one figure.

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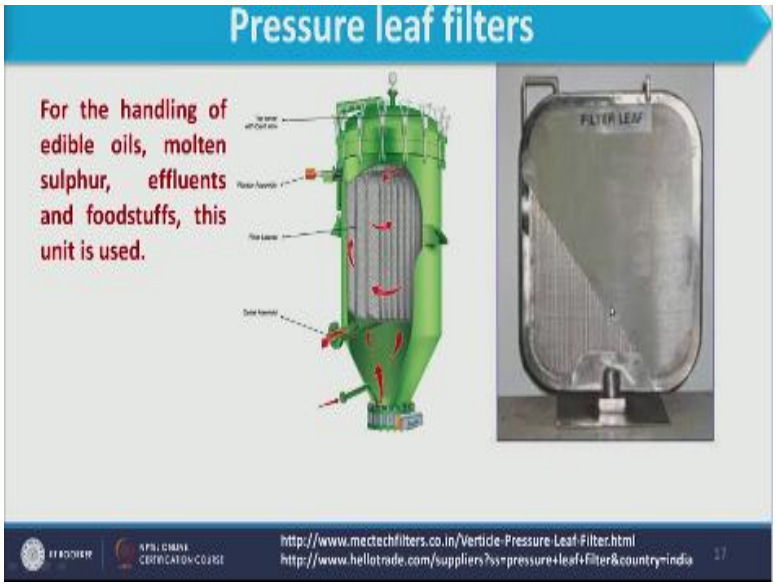

If it has the wire mess in the small in the size and you here and consist of the mesh in the fun size. So what you see in the passes through these leaves the particular leaves. So after to continuous operator what happens the fee enter s in the both surface of the leaf the cake formation and carrying out to filtrate will be collected in the leaf has more many single leaf in the layer of the mesh wire in these all in the case in the posit ate at out the mesh only the outer surface of the leaf only the filtrate to penetrates and that is collected through this.

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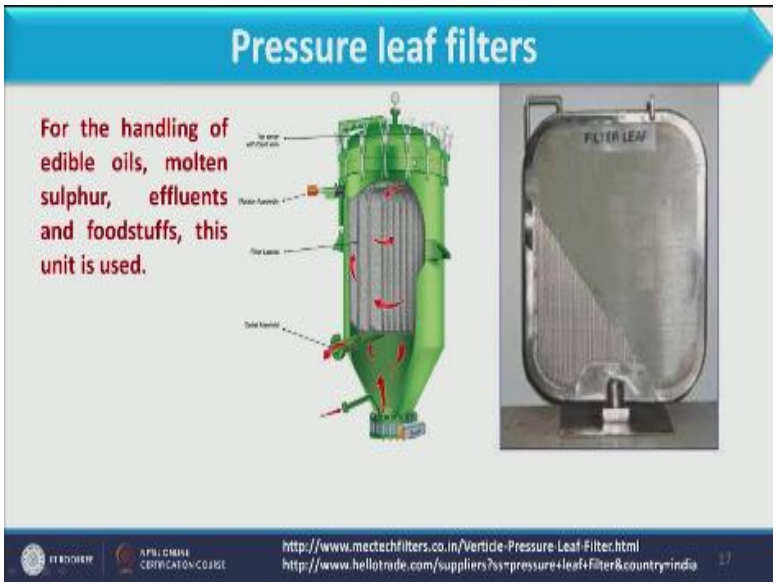

And the pipe if you see all these leafs are concert with this pipe where the filter which is filtrate the falling in between the inside the leaf it s collected through this pipe.

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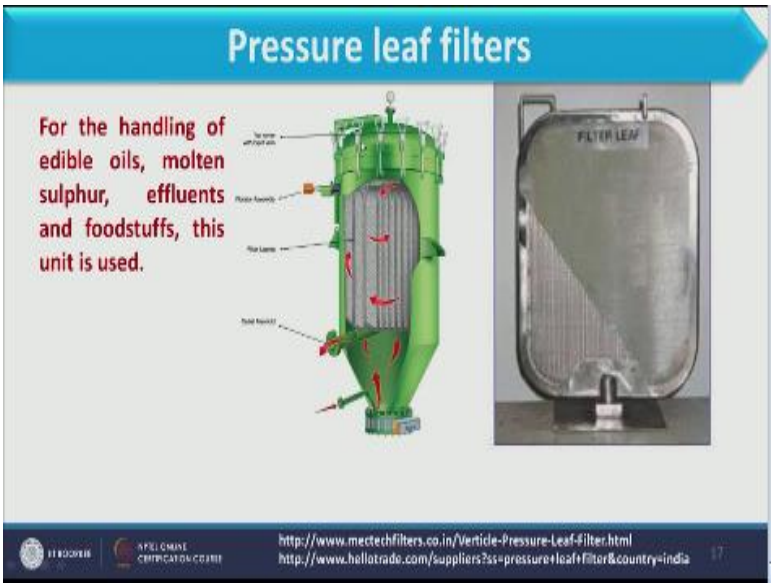

Wherever when we consider other accessories over here, here we have the leaf and this is the complete assembly. We have already discussed how filtrate is collected but how cake collected that we have not discussed so cake is collected through this vibrator assembly, now what happens once operation is carried out due to this vibrator assembly the vibration is done in the leaf so this leaf will remain at the vibrating position till cake formation over the surface is removed.

So due to vibration cake deposited cake dropped at the bottom and if you see here we have the nozzle through which we can collect the cake so filtrate is collected through this pipe however cake is collected through the bottom nozzle. Now if you see here we have top cover with debit arm, so what happen this if we see this structure this is basically use to tide the cover with the vassal. So it is used for the handing of edible oils molten sulphur effluents and foodstuffs.

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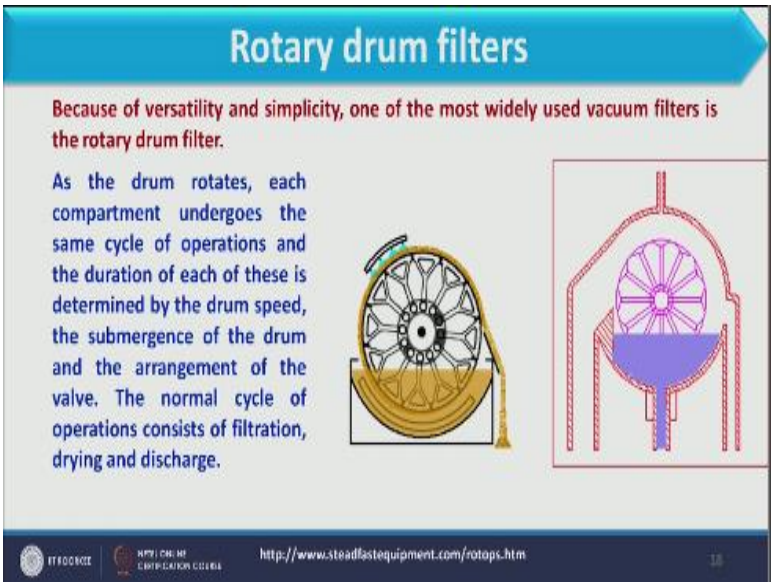

Now next equipment we have is the rotary drum filters, the working of rotary drum filter we have already discus in continues filtration just we will go briefly to this, now if you see this is the animation of this here some section of this is some merge in to this liquid and due to vacuum its sucks the water it sucks the filtrate and cake formation happens. Once cake formation happens after that d watering is done d watering because the some moisture is available in the cake and after that we have washing then d watering and then continuous removal of cake like you see in this figure and you can also absorbed the removal of cake from this figure.

So if you need to study about this in detail you can go through this website, so because of versatility and simplicity one of the most widely used vacuum filter is rotary drum filters. As the rotates each comportment under goes the same cycle of operation and the duration of each of this determine by the drum speed the sub mergence of the drum and the arrangement of the valve, the normal cycle of operations consist of filtration drying and discharge.

So you see there are different steps in valve in filtration and that all steps are covered in single rotation in rotary drum.

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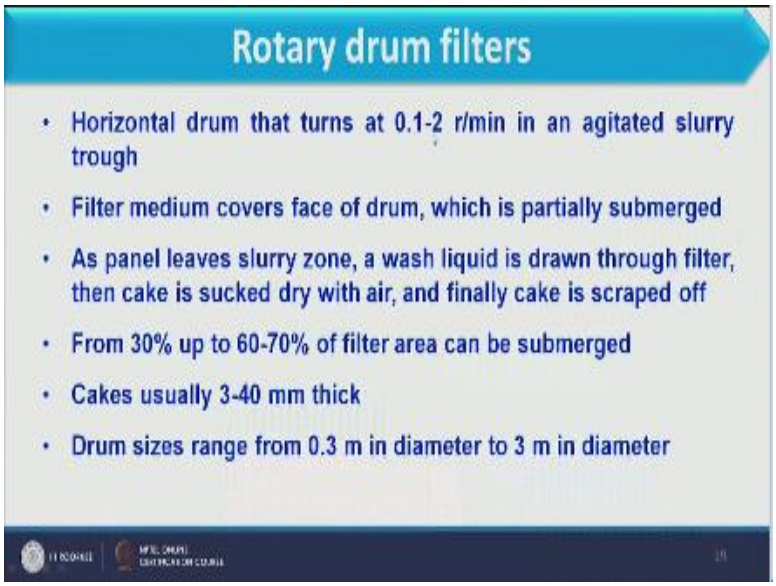

Further horizontal drum that runs at 0.1 – 2 rpm in an agitated slurry trough. The filter medium covers face of the drum which is partially submerged, so you see filter media is covered whole of the drum but is some of the section is merge in to the slurry. As panel leaves slurry zone a wash liquid is drawn through filter then cake is sucked dry with air and finally cake is scraped off. From 30% up to 60 – 70 % of filter area can be submerged cakes usually 3 – 40 mm thick whatever cake we found in rotary drum it has thickness from 3 – 40mm.

And drum sizes reach from 0.3m in diameter to 3m in diameter. So these are few factors about rotary drum filters.

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This is how in industry looks like this you can see from this image you can go through in detail to this website and you see this is basivclkly8 the knife which continuously removes the cake.

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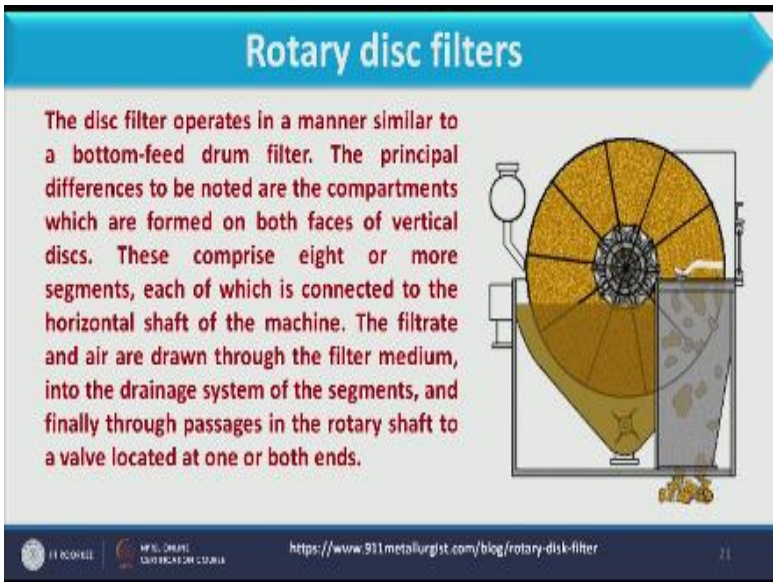

Next equipment we have is the rotary disc filter it is also operated under vacuum but as we have seen in rotary drum filter the cloth is available at outer edge of the drum, however in disc filter what happens cloth is covered to the disc and that disc is associated one and that disc is attached to the shaft very near to each other. So if you see this image we can illustrate how it is working if you see this disc it has different sections and each sections sucks water.

So some surface of this rotary disc is some merge in to the slurry it sucks filtrate and cake formation occurs over here, so you see this is the disc so another side of this disc also contains the filter media, so cake is deposited on both side of this disc. So after deposition when cake when disc moves it whatever moisture is available over here that water is slugged by the vacuum and then again washing takes place and then dewatering takes place all happens in one rotation.

Now at the end what happens in rotary drum at the along the length knife is there but in this along the radius knife is there in disc, so this knife continuously remove cake formation from both side of the disc. So this is the basic principle of rotary disc filter.

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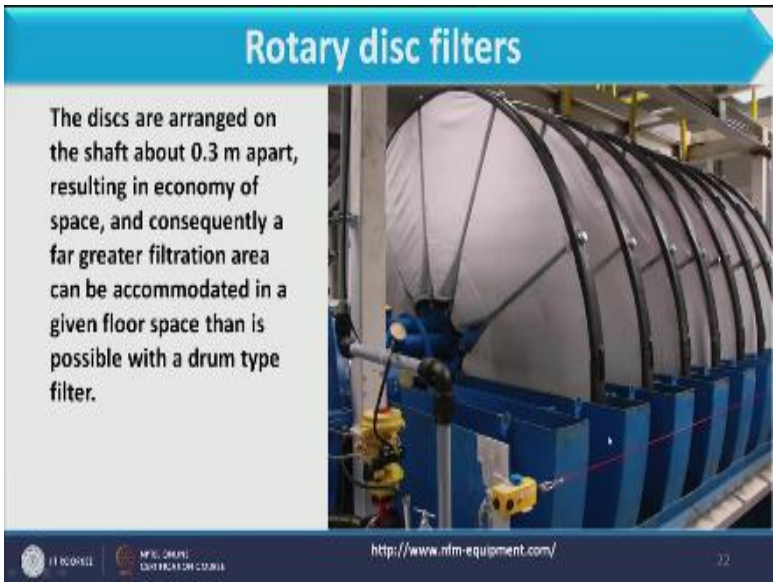

In this image you can see the disc and how this disc are attached through the shaft that you can see in this figure, now each section this is one section each section is associated with this pipe if you see here this is connected with this pipe so whatever filtrate is collected because cake is formed on this surface on both side of the disc And filtrate which is collected is pass through this shaft.

So at another nozzle, so at another end the filtrate is collected and this is formation of cake is done over this surface which can be removed from this knife which is radically attached to this disc. So this disc are arrange on the shaft about 0.3m apart resulting in economy of the space and consequently a far greater filtration area can be accommodated in a given floor space then is possible with the rotary drum type filter. So disc filter are more effective in compression to drum type filters.

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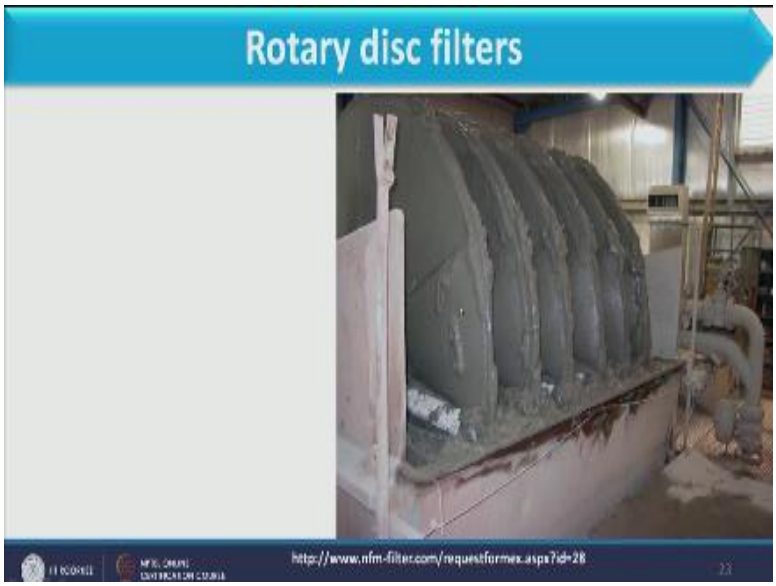

And here you see another image where the cake is continuously collected from the outer surface of the disc for more you can visit this site, so in this particular lecture we have discussed different equipment which are used in industry some are operated under pressure some are operated under vacuum.

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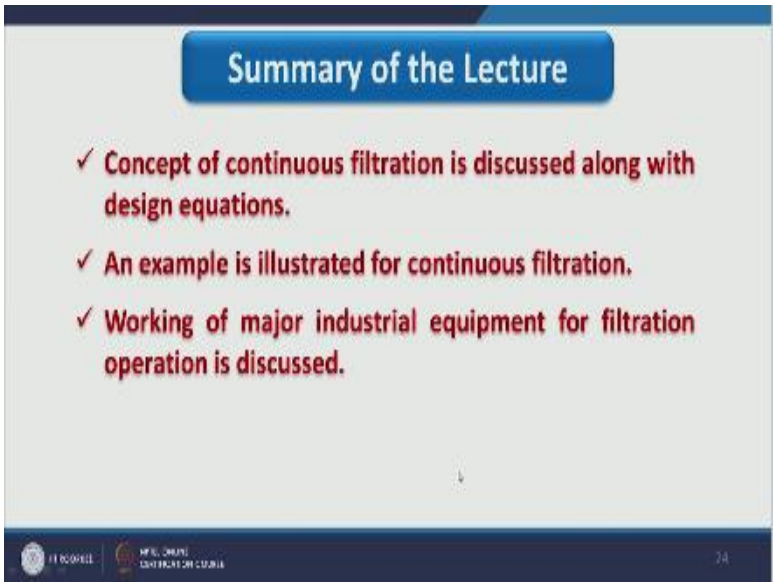

And now we have the summary of this lecture, you should understand that here the summary four as well as lecture 5, so in this series the concept of continuous filtration is discuss along with design equations and example is illustrated for continuous filtration and working of major industrial equipment for filtration operation is discussed.

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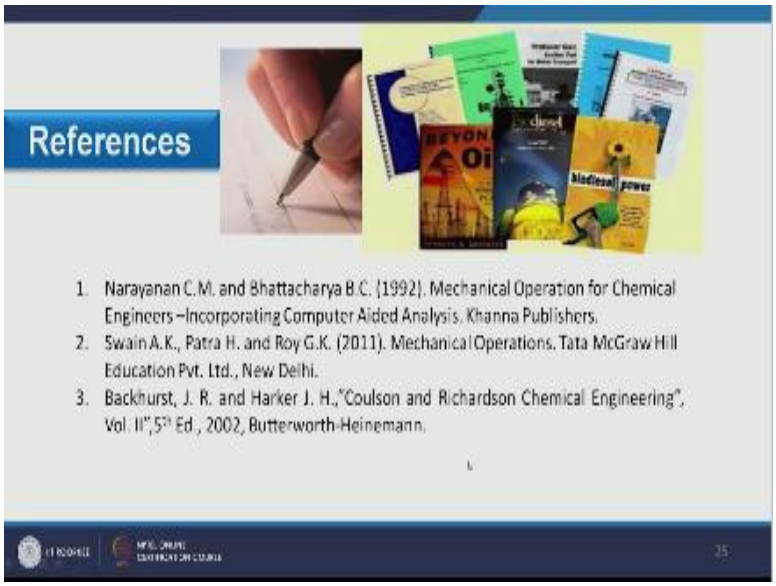

And here we have the references you can go through these books and that is all for now thank you.

For Further Details Contact

Coordinator, Educational Technology Cell

Indian Institute of Technology Roorkee

Roorkee – 247667

E Mail: etcell.iitrke@gmail.com. etcell@iitr.ernet.in

Website: www.iitr.ac.in/centers/ETC, www.nptel.ac.in

Web operations

Dr. Nibedita Bisoyi

Neetesh Kumar

Jitender Kumar

Vivek Kumar

Camera & Editing

Pankaj Saini

Graphics

Binoy. V.

Production Team

Jithin K.

Mohan Raj. S

Arun S

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