Water Management
Professor Dr. A. K. Gosain
Department of Civil Engineering
Indian Institute of Technology Delhi
Lecture 40
Drip Irrigation System (Continued)

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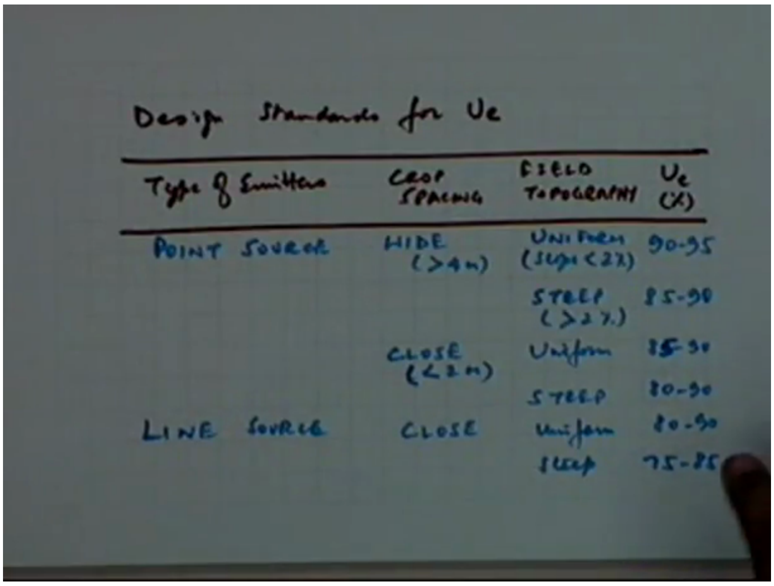

We were discussing the the recommendations which can be useful for the selection of these different types of emitters with respect to the emission uniformity and there is a table which has been provided by the American Society of Agriculture Engineers on the design standards for the emission uniformity which gives the emission uniformity which is achievable or which is possible for different types of emitters and also with respect to the crop spacing, the field topography is another parameter which have been used in this particular information and the emission uniformity in percentage.

Now if the emitter type is a point source type and your crop spacing is wide, in this case wide is taken as more than 4 meters, field topography is uniform and the uniform is the category where it has been the slope has been taken as less than 2 percent than the emission uniformity can be between 90 to 95 percent. If you have steep slope which is greater than 2 percent your emission uniformity will reduce in comparison to the previous case, on this case everything else is same you have the point source where the wide spacing crop but your field topography is steep or undulating then this will be the achievable uniformity coefficient or emission uniformity as it is known in this case.

If you have close spacing which is taken as less than 2 meters the spacing between the crops is less than 2 meter the spacing between the plants and you have uniform field you can achieve the same value of emission uniformity if it becomes the case of a steep topography I am sorry this is 85 to 90. So if it is a steep topography with the close crop spacing you will have the emission efficiency of 80 to 90 percent.

Then you have line source and the close crop spacing normally in the case of line source you will be using the line source mainly when you have the row crops. So you will in general you will find that the crop spacing is close in all the cases when you use a line source there is only one case when you have the close crop spacing, if the topography is uniform thus if it is steep then you have a lower level of emission uniformity.

So this gives you a range that how the emission uniformity changes with respect to the the various conditions prevailing in the these are the general guidelines the general average values which have been observed.

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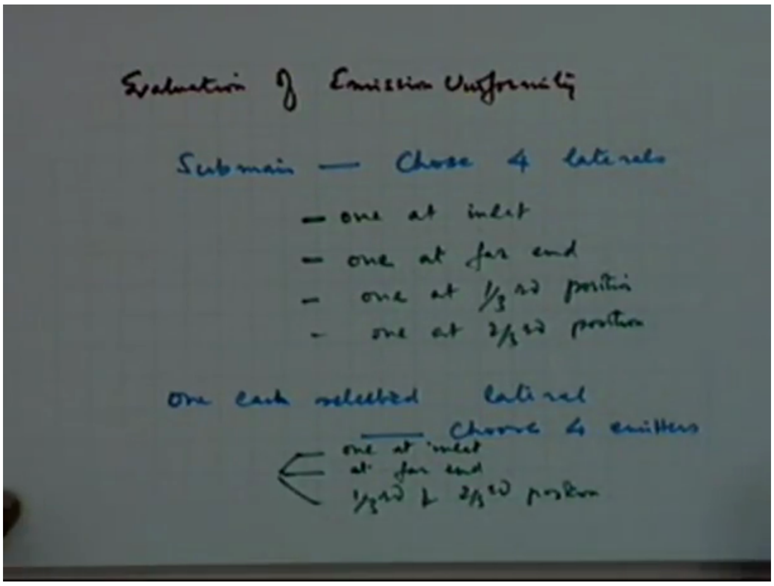

How do you evaluate evaluation of emission uniformity because emission uniformity is something which you will have to go in for the evaluation of such uniformity what is the is a field level data which has to be evaluated and then you can find out what is the level of emission uniformity as we have seen in the other cases also how the other irrigation systems you have to go in for these evaluations where you do some experimentation and then come out with the the relevant values and see check for yourself whether those values are really prevalent in actual case or what you are getting is much different than what is what is said to be achievable.

Now this you if you look at the overall layout which you have you have the main line, you have the submain, then you have the laterals on the laterals you have the emitters. So when you go in for such a evaluation you chose one sub main on the submain if you have a submain chose at least 4 laterals on the submain. You can have one lateral at the inlet point where the very first point on the the submain the very first immediately first lateral at the beginning of the submain and you chose one at the for this point, you can take another one at 1/3rd position and the fourth one at 2/3rd position.

The idea is to have these laterals the selected laterals well-spaced so that you are not getting the sample as you are trying to collect only some sample values. So these sample values should be represented values they should be representing the various conditions which are prevailing in that setting. So for that purpose is very essential that you chose the because what you are going to do you are going to make measurements on what is the actual discharge only then you will like to or you will see that what is the actual discharge which is being made available at different levels of the emitter.

So you have you have tried to make a selection of those those individual emitters in such a way that they are representing the average conditions not the average conditions the average conditions you will find out but they are representing all the conditions the maximum conditions, the minimum conditions and the in between conditions also.

Similarly you can when you come to suppose you have selected 4 laterals on each of these laterals again there will be variation when you go from one emitter to another emitter because of the fact that as you know that there are losses which are taking place there is the discharge which is reducing. So all those thing which you have already discussed with respect to the sprinkler irrigation system is happening here also.

So on on each selected lateral again chose 4 emitters and these 4 emitters again you will have one immediately at the first one the inlet, then the next one at far end that is end of the lateral and then two one at 1/3rd position and the second one as 2/3rd position. So you are repeating a similar pattern which you have done over the laterals. So within the lateral also you are you are trying to adopt the same strategy.

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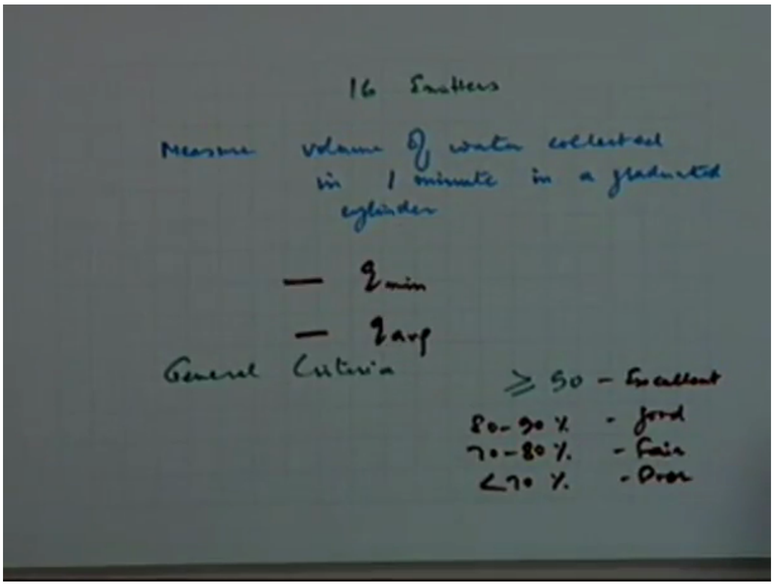

Now ultimately you have now 4 laterals and on each lateral you have 4 points 4 emitters which you are selected. So you have in all 16 emitters where the observations have to be taken the observation is only the you measure the discharge measure the volume of water collected in 1 minute and that you will convert to find out what is the flow rate, what is the discharge.

This you normally have the volume you collect in a graduated cylinder where you can directly see that how much is the volume collected and thereby you can find out what is the what is the rate. So the quantities which you will like to find out is was the minimum discharge since you have those 16 individual values you can find out what is the minimum q minimum is required when you try to find out the emission uniformity, so q minimum is required you can find out from there the q average you can again find out the average of those 16 individual values and all the other things are known.

So you can now from this sample you can find out what is the value of uniformity or the emission uniformity. The general criteria which you normally have which is which is used that if you have more than 90 percent emission uniformity is excellent, if it is between 80 to 90 percent good, 70 to 80 percent is fair, but anything less than 70 percent is poor. Now this is the this any way you have seen earlier but this is the sort of level of general level of acceptance which is given by this that if you have something upto 80 percent of emission uniformity which is reasonably good and you can can accept that.

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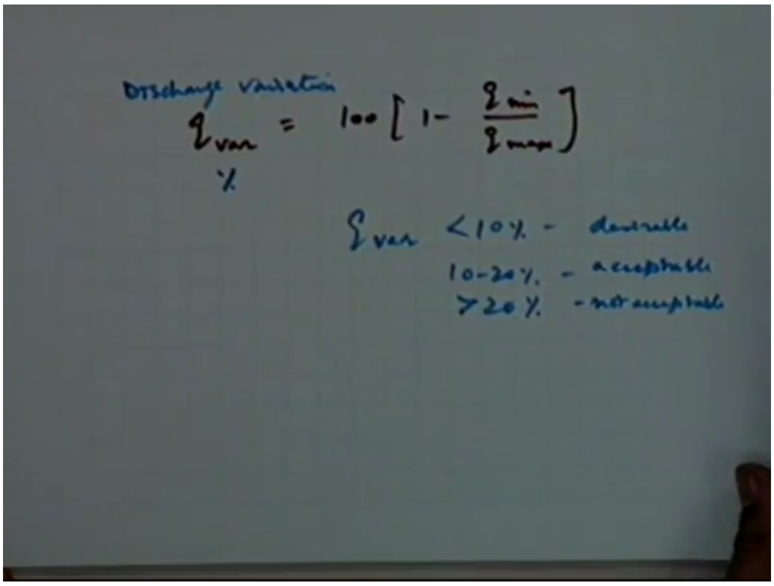

Now similarly you have seen that in this particular case the only thing which is not not known is the the value of the coefficient of variation can also be computed basically using these individual values you can find out the coefficient of variation but if you if you do not want to indulge in all that you want to have a order of magnitude or simplified way of finding out what is the uniformity, what is the level of uniformity which you are achieving.

You can also use a parameter which is known as the discharge variation and this is a much simplified expression then what we have been discussing so far which just gives you what is the what is the q maximum, what is the q minimum and what is the the level of q variation this is again in percentage. So the q variation in percentage is simplified way of finding out this can also be used if you do not want to indulge in all the other the detailed calculations which you are performing when you are finding out the emission uniformity you can also use this as a indicator.

So in this particular case everything is defined we do not have any any term which is this is the discharge variation and the general criteria is that if your discharge variation is less than 10 percent is desirable, 10 to 20 percent is acceptable, but anything less than anything greater than 20 percent is not acceptable. So if you are trying to find out these the discharge variation in terms of the discharge variation this is the range which is the general criteria which is used.

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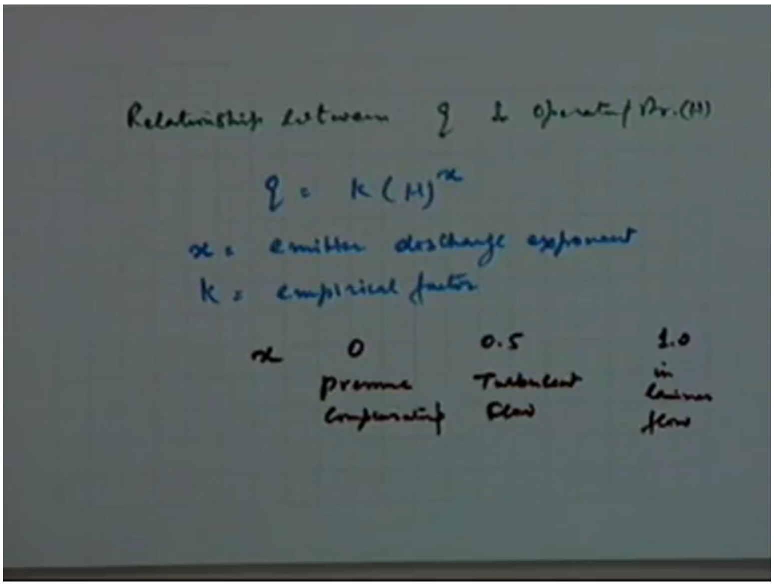

Similarly when you talk in terms of the relationship between the emitter discharge and the operating pressure let us call it H, the general expression this is the relationship between the discharge and the operating pressure. Now x is the emitter discharge exponent this exponent is also given by the manufacturer you will find that the value of this x will also be made available but this x is also a function of the flow regime and K is a empirical factor.

Now the value of x varies from 0 to 1, you have a value of x is 0 when you have emitters which are the pressure compensating, you get a value of 1 or those emitters which are in laminar flow regime and a value close to 0.5 is obtained for emitters which are in turbulent flow regime. So in general you will you will you can you can derive from this that the higher the value of x you will have to take more care in terms of the fact that if the value of x will be higher than a small pressure variation can make lot of variation in the discharge. So that is that is very when is a indicator that if you have a level of x or the value of x which is higher you will have to be very careful when you are looking at the variation of discharge over the lateral and the you have to you have to check you have to make thorough checks that what is the what is the variation which you are getting in actual case.

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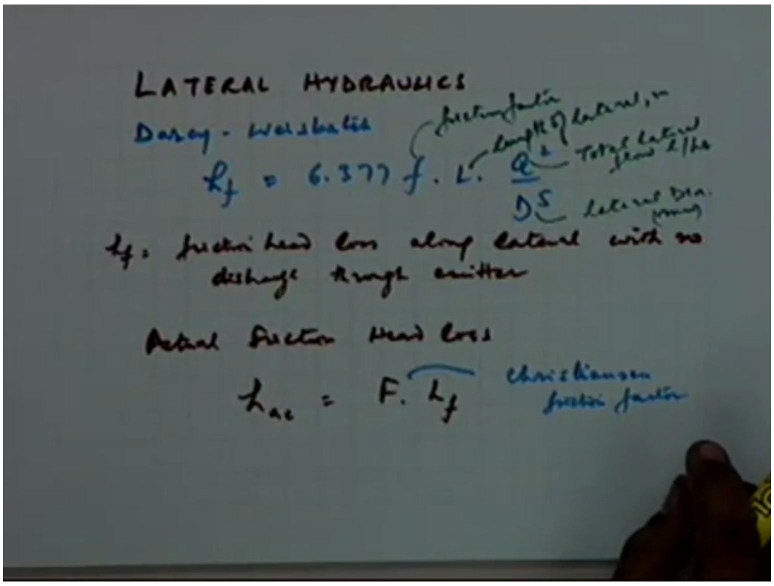

Let us now go on to the the lateral hydraulics now we want to find out the final aspect of design that what is the actual losses and now you want to find out the pump requirement and for that you will have to find out how much are the losses, what are the pressure requirements, how the pressure varies over the total network, the relationships might be slightly different but the philosophy is the same as you have in the case of sprinkler irrigation system.

So I will not go into the details as in this case the total dynamic head which is required the principle is going to be the similar the only thing is that in this particular case there will be some additional things which might create more hindrance in terms of the loss. For example in this case the losses which will be prevalent because of the the the other equipment like the filter unit you have more number of filter units in this because you want still the water which is more curer because of the fact that in this case the clogging much more problematic.

So any pressure which has to be lost in those those individual equipments has to be (()) (24:09) in terms of the local or the total requirement which is required at any level whether it is the pump level or whether it is the the procedure will remain same you will start from the for this point and you will reach upto the pump and find out how much is the total requirement at the pump level.

As far as the other aspect of using the the factor f to take into consideration the effect of reduced discharge is again the similar which we have already looked into in detail in this in the case of sprinkler irrigation system.

Now let us try to go through the some other aspects for example in this case again the head loss for a particular lateral the head loss is found out choosing the Darcy-Weisbach equation which is more common in this particular case and this is the expression to be used for using the Darcy-Weisbach equation for finding out the the head loss, this is the friction head loss assuming that there is no loss of discharge or the the lateral.

So this h f is the friction head loss along the lateral with no discharge if you have there is no discharge through the emitters that means is only the pure pipe flow as you have seen earlier then this is the the expression where all the other terms we already know we know that this is the the friction factor and this friction factor has to be computed using the the proper equation depending on the which regime you are in this is the friction factor, this is the length of the lateral expressed in meters, q is the total lateral flow in litres per hour and D is the lateral diameter and this is expressed in millimetres.

So again we have earlier also we have seen that to account for the actual friction head loss we had introduced a factor F if we call that as actual that is F times h f and this F this F is the Christiansen friction factor and we have in detail we have dealt with that how to compute the F that procedure will remain same. In this particular case the only major difference is that in this particular case there are other losses which are which can take a very significant value, which are those losses upto this place there is no problem is the same procedure.

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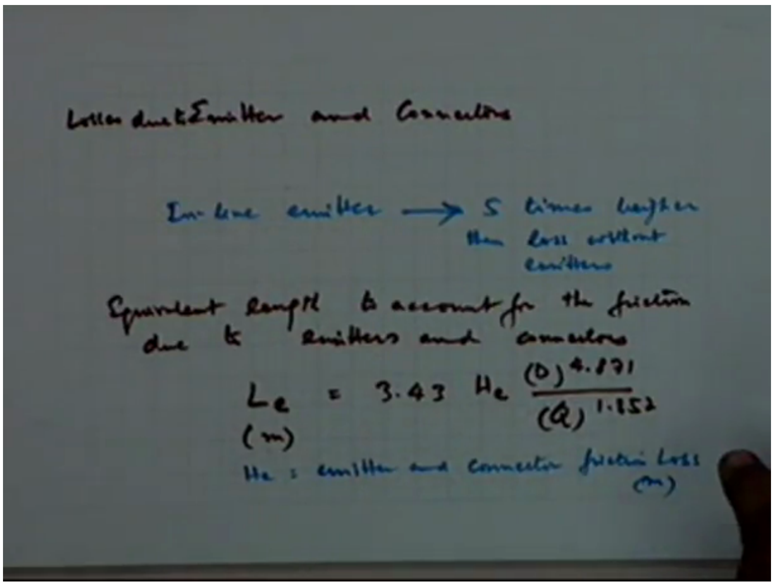

But in this particular case we cannot ignore the other losses which are the losses due to the emitter and the other connectors. These losses can be the order of magnitude can again be very high that we have just said but more than that it also takes it also depends a lot on how the emitter has been used, if the emitter has been used online the loss will be different, if the emitter has been used inline the loss will be different.

So in general the emitter which is used inline it will create much more higher loss than the emitter which is used online. Some experimentation has been done where it has been seen that the inline emitter can have loss which is around 5 times higher than the the loss in the lateral without emitters. So it can even sub pass the total loss of the emitter when in the lateral when there are no emitters that is the h f which you have just found when you have the in line emitters the loss the additional loss can be 400 percent higher.

Now to account for this additional loss what can be done there are various ways by which you can handle that but the designers have found this the simplest possible way they have found is to find out what is the the additional length, what is the equivalent length which will produce the same level of retardance or what is the equivalent length which will which should be taken along with the the original length to account for this loss. So the that is the very indirect way of handling this the connector and the emitter loss that is quite effective.

And the equivalent length to account for the friction due to emitters and connectors is called L e expressed in meters and the expression is used to find out this equivalent length. In this equation what are the various parameters these we have defined earlier this is the lateral diameter, this is in millimetres and q is the flow rate in litres per hour H e is the emitter and a connector friction loss in meters.

Now this this emitter and connector friction loss has to be made separately in the field set up you will have to find out how much is the the loss under for specific emitter or any other connector which you are using and that experimentation has to be when there are many emitters where the friction loss, the connector loss and the emitter loss are not known people are making that available even the manufacturers have started looking into those things.

So once that is known then you can find out what is the equivalent length which has to be increased by which the original length has to be increased and then you can use the combined length in the other previous expressions to find out how much is the how much is the change because of this additional head loss which is which is because of these connectors and the emitters. So that can be taken care of, okay.

Otherwise all the other details remains same you can again you can look at the worst possible lateral or any lateral which you feel is the critical one and if you have a computer system where the program is there you can check each and every lateral and find out what are the the whether the extreme critical points they are getting satisfied value of discharges or the pressures there are quite sufficient and those pressures can be used to find out the pressure requirement at the other locations of the system.

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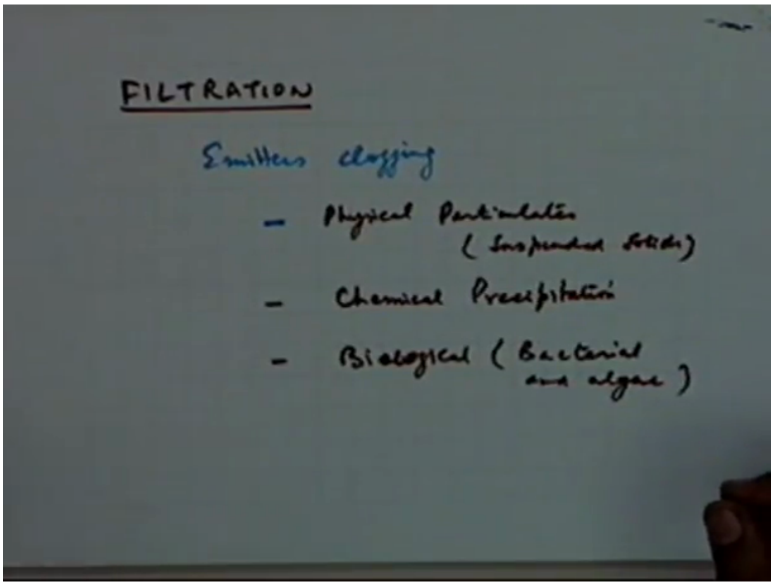

Now that in general gives us a reasonable insight into what are the various design procedures then there are some other related topics for this specific system. In this case the filter unit is very important unit and the filtration is is basically required because of the fact that the emitters get clogged, the clogging in the emitters is due to various reasons it can be due to the the suspended solids, it can be due to the physical particulates, the clogging can also take place because of chemical precipitation, or biological activity can be either bacterial activity and the algae formation.

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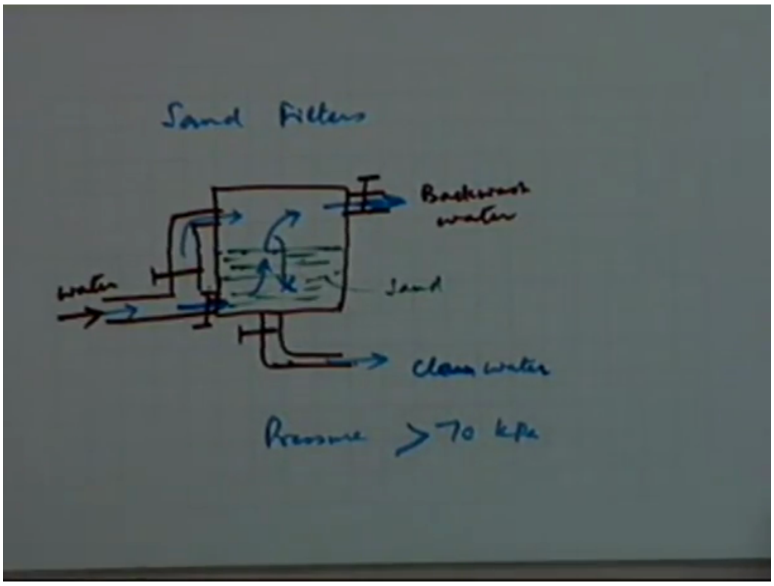

So they are the different range of reasons for clogging and that is the reason that you will have to use a very high level of the filtration process there are many filters which are commonly used they are they belong to different classes, they are some filters which are called the media filters where you are using the sand or some other gravels same type of filter which you use for the civic treatment and when these type of filters which are sand filters which are quite useful and the quantity of the water which can be treated that can also be much larger because of the the the infiltration rates which are prevalent and it can also remove the not only the sediments but it can also remove some of the biological elements which might be going through the water.

So in the case of a sand filter a typical sand filter you might have such a arrangement that you have you have a unit where you are this is the entry of water water comes through this and these are the various levels where you can have the control now in the if this is the portion which is having a filter medium as a sand. So in the normal operation the water will move in this direction come here and then pass through the filter unit and move out so this is the clean this is the clean water which is coming out of the outlet point.

Now this part is used when you want to have the backwash of this filter because all the material which is the different types of particles which are getting accumulated on the surface of the the filter they can be backwashed by sending the water closing this this side sending the water now from here and then the water will while passing through the sand will remove the the particles which are deposited and it can be sent out of this so this is the backwash water.

Now this process can be repeated as often as is required depending on the capacity of the filter and the type of water which you are using, how much how much deposit is being made in this particular area and that is why if you remember that you have the pressure gauges also which are provided before the filter and after the filter unit. So you can calibrate that in terms of the pressure difference also, if the filter unit gets clogged the pressure variation will also increase.

So if the pressure variation is more than 70 Kilo Pascal then in general you can say that you require the filter to be cleaned. These days there are many new equipment which have come because the difficulties which were earlier being faced by the operators they have a dual they have a twin system the filter can have two chambers one chamber can be used when the other chamber is being cleaned through the backwash process. So that you do not have to you do not have to stop your system you can do that when the system is is remaining on and the lost time because if you have chosen a system where you cannot wait for let us say for more than 1 day for the next irrigation to start otherwise you will you might not be able to complete your total area in the desired irrigation interval.

So in that situation each lost day can be very detrimental can be very problematic. So you can either use a filter unit which needs very little cleaning or is very quick to to be cleaned or you use such a system where you have a standby which is inbuilt so that you do not have to stop the functioning only because of the fact that you have to clean this filter unit.

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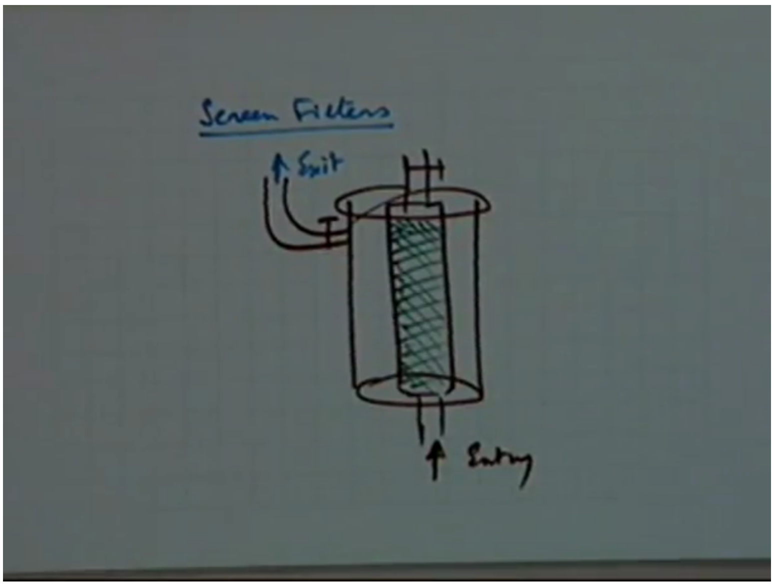

Then you have the other type of filter units which are quite equally popular they are the screen filters. In the case of screen filters you use for filtering the wire mash and you might have such a situation that you have here you have a core which is which is having a mash. In this case the water will be entering from this end this is the entry point, water goes through the and then so this is the exit the exit point so the water when it moves through the filter unit it can is not as simple there can be a situation where it will move the length of the segment which it has to pass through it can be forced to the water the water can be forced to pass through that total segment so that the cleaning is much better and much proper and then the water the clean water will come through.

Now in this case again this is the the outlet which can be used when you clean the filter and you want to flush the whole (())(47:54) out of the this wire mash portion which is the filter portion in this particular case. The sizes of these mashes can vary depending on the requirement, depending on the quality of the water which you are using. So that in general is the the very brief details on the filter units and there can be another type of filter unit where you are using the the concepts of the centrifugal force there you try to (())(48:35) the water and if you have only the suspended solids which you are which are heavier than water that can be forced to settle down and through that those type of filter units you can only remove the suspended particles which are not exactly suspended particles they are in transition, they can be forced to settle down.

So those type of filters you might use as the primary filters which are only the first level filters then when you come closer to the sub mains use the secondary level filters which are more effective which can be which can ensure that all the (())(49:23) all the other particles which can clog the emitter they can be removed.

So with that I will close this topic on the drip irrigation system, if there are any questions okay. Yes the question is that whether the the sand filter and the screen filters they can be used simultaneously, there are filters which are having both these things put in the same segment also but they can be they can be used the the screen filter can be used as the primary filter because screen filters are not as effective as the sand filters can be.

So that is basically which filter should be used where and how many filters you have to use will depend on the quality of the water which you are using, if the quality of the water is very poor you might have to use series of filters, you might have to use even a filter which is before the pump units because that can also if the water is really bad you will not like the pump to be damaged.

So you might use a filter even before the pump. So it all depends on it all is dependent on what type of quality of water you are having at your disposal and in some cases you might find that you will have to analyse the water if your quality is susceptible or if there are situations where biological activities quite active you might have to go into the depth into the (())(51:38) because you realize one one main aspect that in this particular case if even if some of the emitters are not functional you are having a big problem because emitter is ultimately the the last device which will let the water move from the system from the lateral on to the the field.

And the pressure once you go pass the emitter there is a very drastic difference is the drastic drop in pressure from the point which is just upstream of the emitter and when you go when the water goes outside the emitter. Let me tell you that the water is almost at the atmospheric pressure when it comes out of the emitter. So if you have any situation where because the pressures are really very low.

So in most of the cases even if there is a very small chance of having any of these things effecting the emitter it will have a tendency to clog, it is there are days when you are when you are not using the system even if you are letting the water stand for 2, 3 days as we have seen that two days is a normal duration which when the the emitter might not be functional. So within that much period if the algae formation is there then you have it, because then it is going to you will not even know the other major problem is that you will not even know that which are the emitter, which are not functioning because there is no think of a situation where you have many many hectors of area and the number of emitters can be really run into hundreds for even a small area, how many of those emitters you can physically see and even the automatic controls are not possible because they will be they will be making a very when the whole system very very expensive.

So those sensing the remote sensing and or the automatic sensing the mechanism is not is not possible, it might be feasible but is not it might be possible but is not feasible you can you can sense how much is the water going pass the emitter that is at a cost which is permissible within the present circumstances. So you have to be very careful at this stage that the water which you are sending is not by any chance is not clogging those emitters, okay thank you very much.