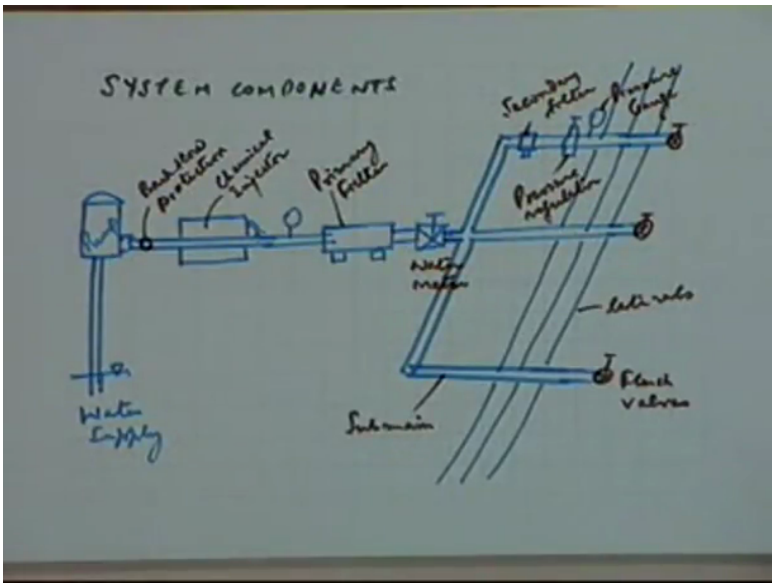
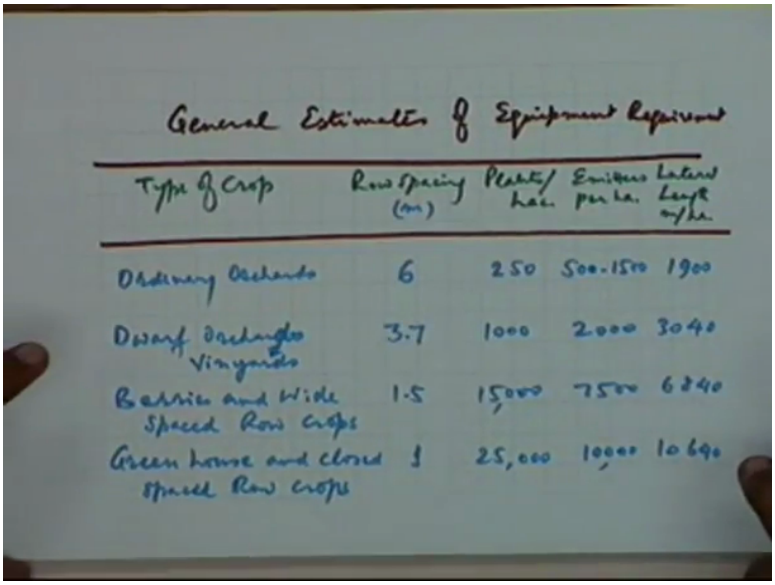
Water Management
Professor Dr. A. K. Gosain
Department of Civil Engineering
Indian Institute of Technology Delhi
Lecture 38
Drip Irrigation System (Continued)

(Refer Slide Time: 1:29)



Yesterday we had started with the drip irrigation system we had looked into the general layout which we might have as far as the main system components are concerned, there can be a variation in terms of the laterals how the laterals are laid that we will see subsequently but in general the other components which are usually present in a drip irrigation system they have been already discussed.

(Refer Slide Time: 2:25)



At this junction we will like to look into the again some thumb rules which have been brought out with respect to the experience and this can be quite a useful thumb rule in terms of the general estimates of equipment requirement. Now these are given in the form of with respect to the type of crop and with respect to the row spacing, the other items which are these details are expressed in terms of are plants per hector and number of emitters per hector and the lateral length, the lateral length is meters per hector.

This is again these are the average values which have been found from various areas of the world it has been seen that if you adopt these values your design will be quite within the range within the required limitations or the constraints which you will like to put the design through, the types of crops are divided into different categories broad categories again and the only categories which have been picked up in this particular table are those which are suitable for this type of irrigation.

So you have ordinary orchards where the row spacing is this is in meters is around 6 meters, the plants per hector in these type of orchards are around 250 and the emitters per hector which are required they generally vary within this range between 500 to 1500 and the lateral length the overall lateral length in meters per hector is around this value 1900 meters per hector area.

Then you have dwarf orchards which also include the vinyards where you produce the vine grapes in this case the spacing is of the order of magnitude of around 3.7 meters and the other

values which are again you can say the average values these are the emitters per hector and the length of lateral which is required in meters per hector.

Then you have another category berries and wide spaced row crops these drip irrigation systems are also being used (())(6:56) for the row crops and two types of row crops have been recognized one is the wide spaced row crops and closed spaced row crops. In the case of wide spaced row crops where the row spacing is around 1.5 meters you have these values the order of magnitudes of plants per hectors, emitters per hectors and the lateral length in meters per hector is this order of magnitudes.

Then you have the category where you again use the drip irrigation system is the green house and closed spaced row crops which case the spacing is still smaller in comparison to the previous case and you have these order of magnitudes. Now this will give you a general feeling that when you talk in terms of the density of this network of laterals which you are going to have it will vary considerably with respect to what is the type of crop in general which you are catering to.

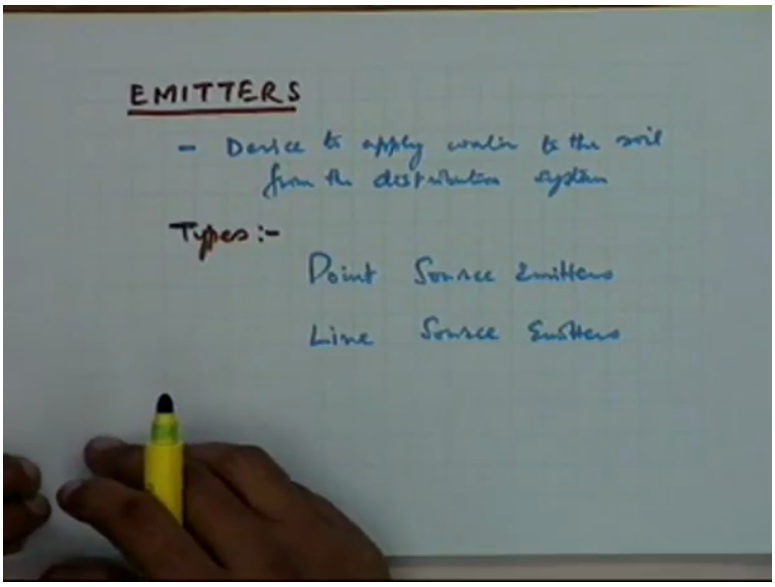
In case you have those crops which are of the type of orchards which are individual tree plants or individual plants the size can vary that is why you have two categories in one case you have the full grown trees, another case you have the dwarf orchards where you have the plant sizes are smaller and their requirements are also going to be less in comparison because of the root system the type of root system they have.

And these are the general the order of magnitudes only because this is not incorporating anywhere the effects of climate and you have seen so far you have seen that the climate has a very significant role to play in terms of the evapotranspiration activity. So the evapotranspiration activity how much is the actual evapotranspiration is going to be decided by the climate only.

So you cannot talk in terms of the specifics because the specifics will vary from one place to another place depending on what is the variation in the climate but since in most of these cases when you talk of a specific type of orchard you will find that since it has its suitability to a particular climate you will have the climate variation very very nominal because if you are talking of vine it has a suitability for a particular type of climate but still is not true that it cannot it cannot grow when if there is there is even a little variation in the climate it can still grow the variety will be different will be some other some other influences of the local

climate but you can have different types of crops or the same crops under different climates and from that angle you cannot assume these things to be the specific values they are only ranges which have been given as a guideline to the designer so that he can get a feeling that how much when you start with the first initial estimate you can start with some value which is reasonable and start refining those designs to arrive at a final design parameter or set of parameters, okay.

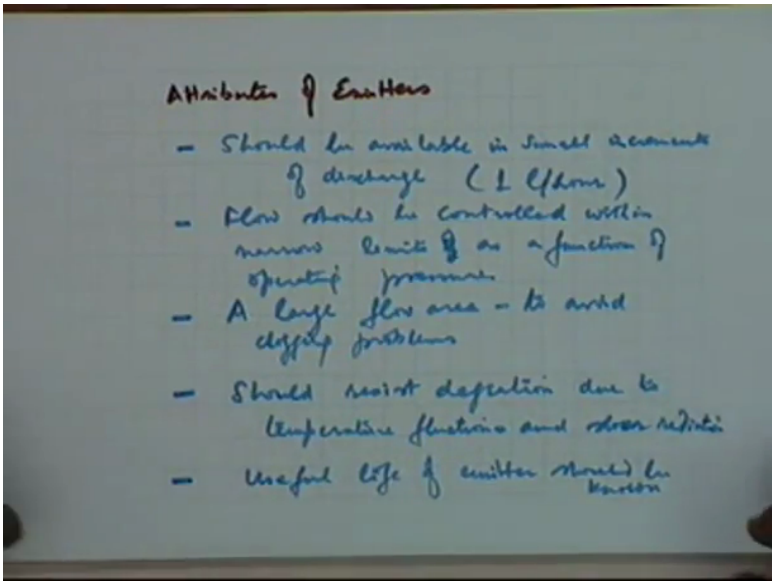
(Refer Slide Time: 11:28)



Now let us go on to the next very important element of this these systems which is called emitters the different names given to this some time you call them drippers, or emitters. So what is the role of the emitter is a device to apply water to the soil from the distribution system. Emitter is the device which ultimately supplies the water from the distribution system onto the ground surface at any point whichever is the point of your interest but we will not talk in terms of the points right now because we are going to discuss the various types of these emitters which are available and is not only a point source it can be a line source also.

Let us let us classify them accordingly if I say the types of the emitters you have two general types of emitters one are point source emitters and the other categories the line source.

(Refer Slide Time: 13:56)



We will come to the what do we mean by the point source and what do we mean by the line source emitters in a short while but before that is equally important to to know what are the attributes of emitters which are generally desirable by the designer you will like to have these attributes in emitter these attributes are there should be the specific type of emitter should be available in small increments of discharge, you should have the category of the or the type of emitter should be such you should be in a position to have different emitters with a very small incremental value of discharge let us say increment of 1 litres per hour, you should have emitter of the same type which is able to give you specific discharge rate or the next one should be having a variation of as small as 1 litre per hour.

Otherwise you will not be able to have a flexibility in the design because in these cases the amount of water which you are dealing with or which you are talking in terms of they are very small. So if you have small increments you will be having a very good flexibility in terms of selection of these emitters and having designs which can be done which can be take which can take care of the requirements all those various constraints quite effectively.

Then the other attribute is the flow should be controlled within narrow limits as a function of operating pressure which literally means that if you change the operating pressure the change in the flow should be again a very nominal.

Then this is another attribute which is important from another aspect a large flow area in general you should have emitter which have a large flow area because of the fact that if you

have very small flow areas you will have the clogging problems. So to avoid the problems of clogging if you have large flow areas it will be much desirable.

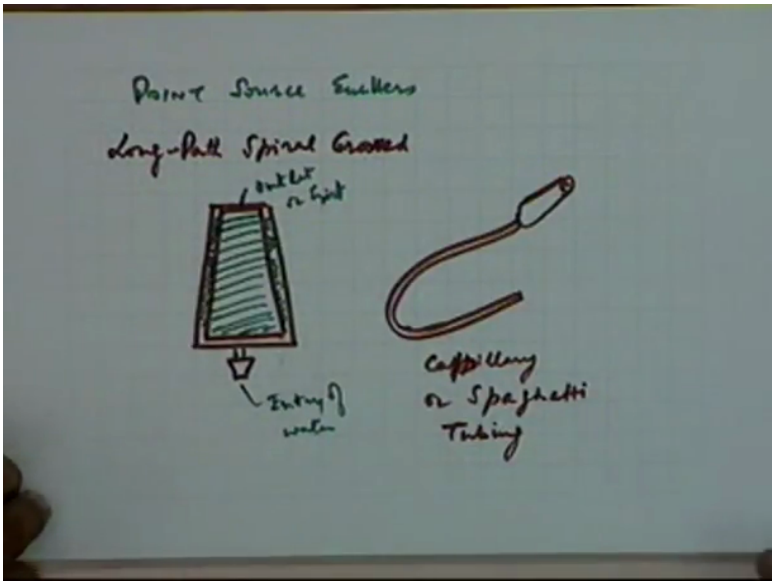
Then the emitter should also resist degradation and the degradation can be due to temperature fluctuation and the solar radiation that means you should choose the material of the emitter in such a manner that the degradation is minimum over time because of the temperature fluctuation which you will normally have in every place and because the solar radiation there are some emitters which might become brittle their design characteristics might change, their behaviour might change after a very small duration of operation.

You should also ensure that the useful life of emitter should be known this is again since all these emitters they have a definite life if the designer is knowing that how much is the life of the emitter when he makes the competitions he goes in for the total cost analysis of the system, he can design the system more effectively if he knows that what is the what is useful life span of the emitter because this is the most important device in the total system because unless the water comes out of the emitter whatsoever you have in the background before the emitters is of no use because ultimately this is you have taken all the trouble you are provided all the other components of the system just to ensure that the proper amount of water flows through the emitters and is dumped on to the desired place at the proper time and with respect to the proper rate.

So if it is not doing that function then it is a wastage of money and your system cannot run successfully you will have to you will have to abandon the whole operation may be.

Now we will go on to the description a brief description of these emitters, what are the various types of emitters which are available because I will be only discussing with you some of the common types which are which are in the market and which are more popular with the uses they are many because this is growing into a very successful and very big industry and you will find that there is a new model coming is lot of research going into this area and since most of the emitters they have some problem or the other and even from the cost point of view to make it more cost effective people are trying various materials, people are trying various shapes, people are trying various sizes of these emitters so that they can have more flexibility, they can give the designer and the user more flexibility in terms of the usage of these drippers under varied conditions if you can use the same dripper in very large range of conditions you will be saving lot of expense which is otherwise will become essential if you have to have different emitters for different types of crops and for different seasons.

(Refer Slide Time: 22:30)



So from those angles you will find that there are many types of emitters which are available in the market and let us discuss some of those which are have become quite common. Now we have two categories as we have just mentioned one is the point source emitters these point source emitters as the name suggest they are applying the water at a particular location at a particular point of the field. So each emitter is trying to (())(22:56) to one individual point of the area that is why they are they are called point emitters.

Whereas the line emitters on the other hand is scattering to a any longer length of the area. So along that line but in both the cases you will find that as soon as the outlets are concerned from where the water is coming they are individual points only. In the case of line source you are having those points more closely placed so ultimately when you look at the area of influence of each individual point in the case of point source they might not having any overlap, whereas in the case of line source they will have the overlap that is why they are two different names given to this.

Let us look at the point source emitters, there are various categories one is the long path long path spiral grooved long path spiral grooved. In this case you have a system where you have this type of arrangement, now this is the this is the inlet, the water enters from here or I will say entry. Now this is this is something this is the nob which goes onto the lateral it just (()) (25:06) the lateral and this is the inlet point.

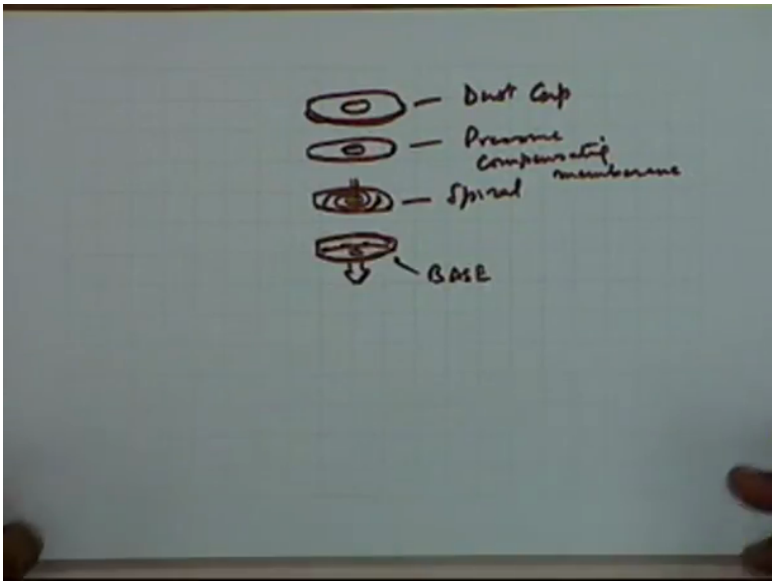
Then on this side you have a situation where you have a groove what is happening is that this is these are small literal spiral groves and all this this is the spiral area. So what you are doing

is that you are the water go around these spirals so that there can there can be some dissemination of energy which is available because in most of the cases the pressure which is prevalent in the laterals is much much higher than the pressure what you want the water to some out with.

So in all these emitters will be one general thing that there will be some way by which some mechanism which has been adopted by which you can have lot of energy dissipation and that energy dissipation in some case is ensured by having more area with the water has to travel. In this case is that only basically the long path spiral grooved that is what the name suggest. So you are having the water enter the inlet and after that inlet you have a spiral path which is very long path just to ensure that the energy is dissipated and then you have the water coming out of this place this is the outlet or the exit point of the water.

Similarly the same thing can also be done by having a long small long tube so accordingly you have another system where you might be having a a very fine very fine tube and the end of this tube you have a a area which is enlarged area again for dissipation on dissipation of energy. In this case this is called capillary capillary or spaghetti tubing and this tubing can also serve as emitter.

(Refer Slide Time: 28:47)

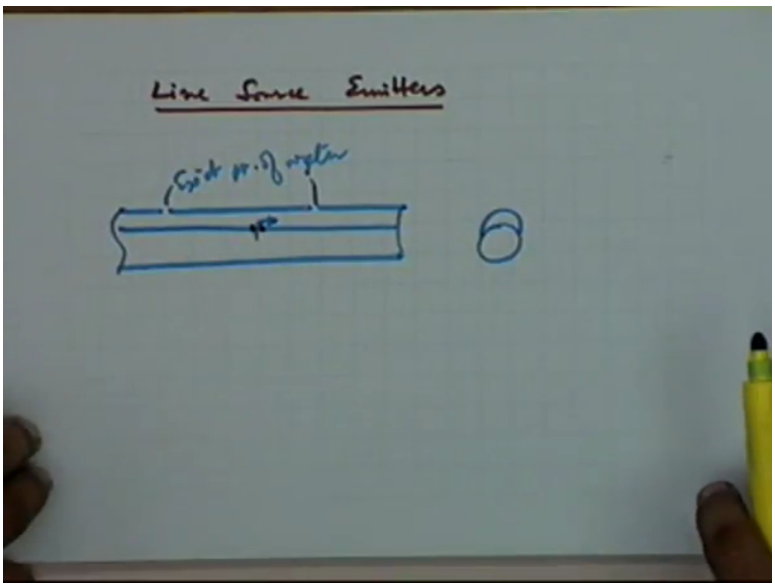


You have another type where you use the a different shape this is basically a again in this case you have this is the lower most part in this case all the components have been shown separately they have been reattached, they are small dis sought of things which are inserted in each other this is the lower most this which is a in the form of a cup and then you have this is

this is called base then you have a spiral which regulates the flow. So that spiral is something of this nature this is the spindle here and then the water which is entering is moving through this spiral, this is the spiral and on top of that you have a a membrane in this membrane this is the flat membrane, this membrane is used for pressure regulation.

Now if you will put more pressure on this membrane then a less amount of water pass through the spiral because of this this is the flexible membrane you will find that if you will have this loosely held there can be more flow which can pass through this spiral if you have the membrane which is which is slightly tightened you can reduce the flow. So this is another and then you on top of that you have a another cap you can have a cap which is used to which is put on the top so that no dust enters the total system and this becomes a compact system when you put them together join them or there can be a screw which can be tightened then you will find that this can be adjusted manually to regulate the flows as per your requirement or there might be some calibration which is given in the in terms of some indicators that how much you have to tighten to get a proper amount of flow these are the various some types of the point source emitters.

(Refer Slide Time: 32:06)



Now let us look at the line source emitters in the case of line source emitter there is only one type of emitter which is very popular and that is basically a combination of two pipes this is the lower pipe if I take the section of this this is the pipe. Now this pipe have openings, this will have a opening here somewhere this level and on top of this there is another pipe which is not a complete pipe which is only a segment of a pipe which is may be half only a is not a

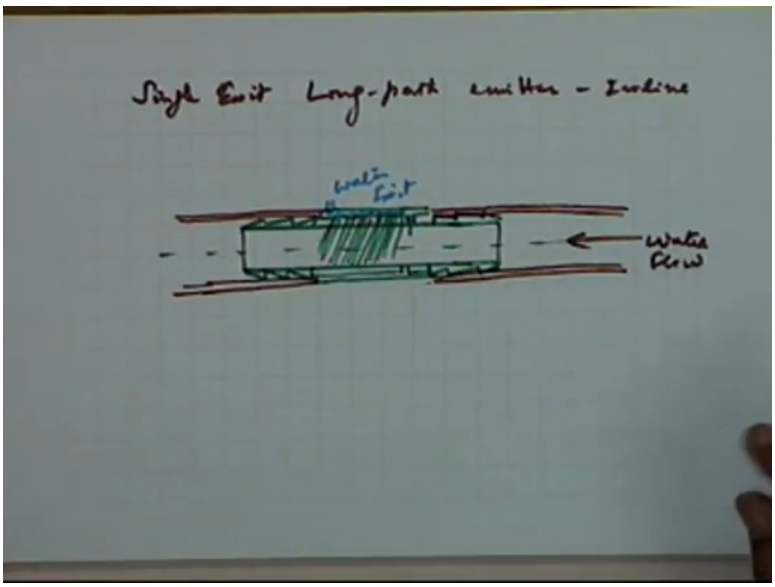
complete circle of pipe only a segment of the pipe which is put on top of this pipe and this is put on top here.

Now this becomes a complete single unit the water moves from this in the pipe the water runs in the in a pipe this is the lateral and then the water goes out of these these openings the number of these openings is much larger than the number of openings from where the water is coming from the inside pipe. So again there is some level of energy dissipation because from this the water is moving into another pipe and the area is very large (())(34:15) will be much lower and secondly is also having the distribution with respect the spacing of these openings.

So this is the exit point for water and similarly there will be more that is what is called the line source because now in this case this length of the perforated tube is basically having is the tube which is having a inlet inside here and then the perforation on the top portion of the tube, this perforated tube can (())(35:03) to the requirements of a row crop much easily than the other type of the point source can take care of now this is another emitter this also will come under the category of emitters but a line source emitter.

Now this is also possible that these emitters which we have discussed they can be they can be placed in different manners in some case the point emitter of a particular type it might be put in line that means the emitter is not attached on the line of the lateral is not a online emitter is in line emitter that means the emitters embedded inside the two ends of the lateral.

(Refer Slide Time: 36:27)



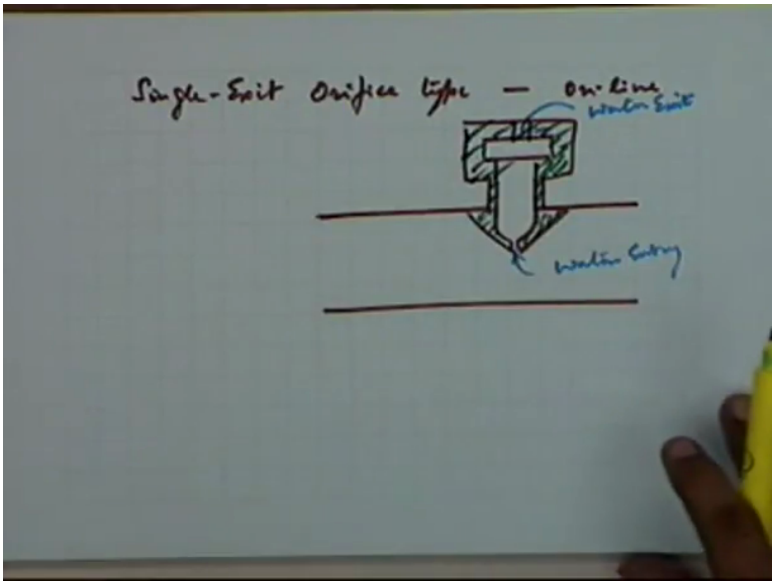
So let us see what are the various arrangements which might be available in different types of these emitters. Let us take a case where you have a single exit long path emitter which is installed in line, in that in this case what you will have you will have a the mechanism or the basic philosophy of the emitter will be that long path spiral strategy through which it will disseminate the energy which is available and we will just make a line sketch of this that this is emitter, this is emitter which is having input in line when we say inline similarly this is the blue one this side and when you say inline that means you have your lateral is put on this is embedded within the section of the lateral.

So this is the lateral the water is flowing from this end to this and this is one section of the lateral, another section is joint through this emitter this arrangement is called the inline emitter arrangement and in this particular case what is happening is that somewhere here if this is the centre line of this pipe somewhere here you have the the entry point through which the water is flowing and entering the spiral.

Now here this section will be having the spiral and the water water moves from this and it goes through this spiral and somewhere here is the water exit. So it will it will move through the spiral around this as we have seen in the previous case and by the time it comes out it will be at a much lower pressure and the discharges can be regulated with respect to the general flow the pressures prevailing in the laterals.

Now there is a case of inline the same thing if you want to use as there are other situations where you have another type of emitter the same the long path emitter which is laid inline but you have more a number of open in the outlets and those outlets might be through the form of some tubings which have been provided at some level here I think I will not go into the design or the variations of different types of emitters because our time is not we do not have that much time to discuss all these details my intension is just to give you the various variations which are possible in terms of the philosophy how we can how many types of emitters we have and how they are used whether they are used inline or whether they are used online.

(Refer Slide Time: 41:18)

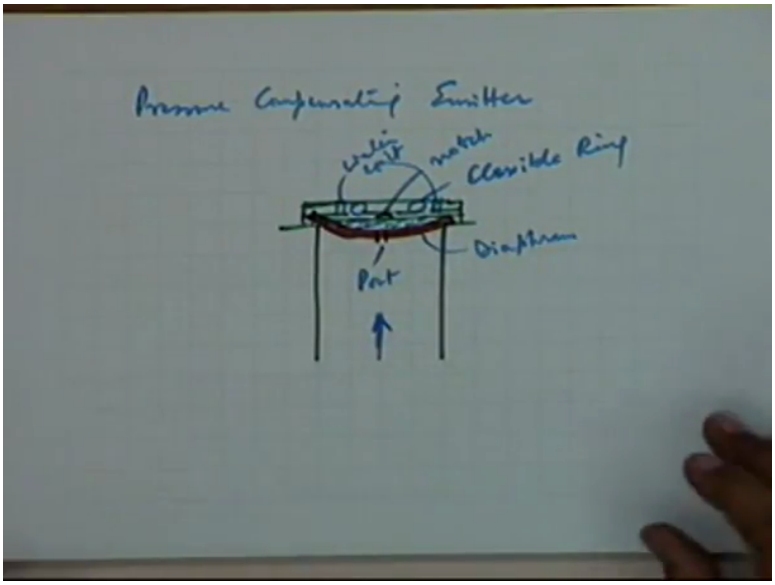


Let us look at a online emitter now which is of the type single exit orifice type emitter which is installed on line. In this case you have a let us say that this is your lateral and you have this is what is the lower end of the emitter which has been (())(42:17) into the lateral and I will make this as a this is the section of the the body of the emitter, the water enters water enters here this is orifice and this particular case you can see that the dissemination of energy is through by having a orifice and then having a very enlarged area and then the water moves out of there is a opening here so then after going through this enlarged area water this is the exit portion of the water.

Another case you might have another arrangement where instead of having this enlarged area you might have a orifice and then that orifice has a spiral area. So in that case will be the it will might have a vertex chamber in which there will be some dissemination of energy and then the water moves out of that. So the basic philosophy remains same, you have to provide some way by which you can disseminate the energy the access energy and also have the sensitivity of this arrangement so that by changing the pressure you must have some desirable change in the discharge that is the basic philosophy then the other things which are important are we already discussed you should not have a situation where it gets clog very fast.

So from those angles you will see that these things they are more in number they are more designs because of the fact that people are thinking in terms of achieving these objectives by having different types of designs and people keep on extracting that is why there are so many of them in the market and you can select one which is which is cheap enough as well as it delivers the (())(45:11).

(Refer Slide Time: 45:26)



There is one more which is which I will just show you which is known by the pressure compensating emitter in this case what they have used is this is only the part of the emitter only we have not shown the lower part, how it is put on to the laterals. So this is only the part of the emitter which is indicated here in this case what you have is that you have on this emitter you have a situation where you have a a sought of this is the flexible ring and along with that you have a a diaphragm.

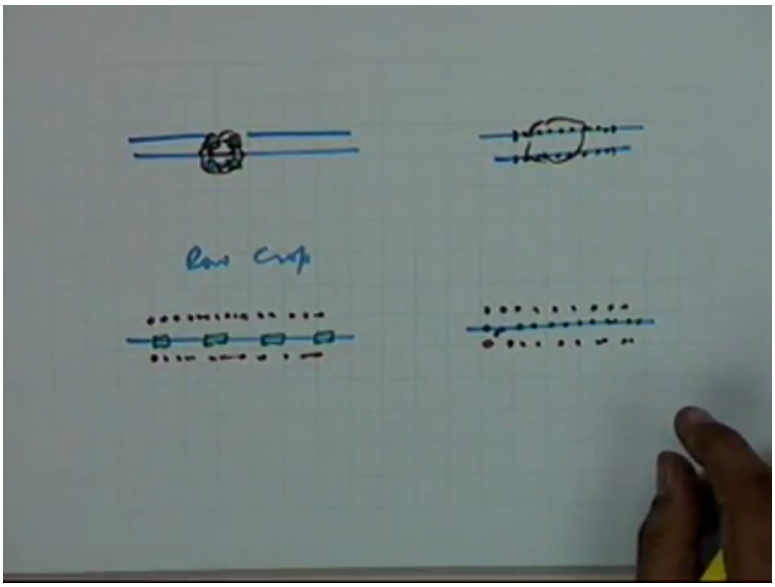
Now this diaphragm is having a port opening here this is the diaphragm. Now this diaphragm depending on what is the pressure here because the water is going from this end and then you also have a you also have a a notch here when the pressure is less this membrane in this position in the present position this is the relaxed position of the membrane, this present position is the relaxed position of the membrane when the pressure increases this membrane will have a tendency to go up and it might take a position which is somewhat here and because of that position it will have a tendency to reduce the discharge, the opening will reduce the this is the portion from where there is a portion here which is connected with this area and this port is also and the port will also have a tendency to get close because of this this notch the closer it will be with this wall it will have less and less amount of water going into the this zone.

So because of that when the pressures are very high it will it will try to have a the position of the membrane will be readjusted to control the discharge and this these are the openings for the water exit. So here again the the mechanism which is adopted is to ensure that by having the fluctuations and the pressure you can have a mechanism by which you can have a control

in the discharge, the discharge should not vary much even if the pressure has has changed through a large extent.

So within a range you can ensure that the discharge which is the requirement the amount of water which you want to come out it should not it should not change much and that is done by this diaphragm which is provided here.

(Refer Slide Time: 50:31)



Now with that I have given you a reasonably good idea about what are the various types of emitters which you will you might encounter when you select from the range which is available. But ultimately the the usage when you use the point source or the line source they can be used for all the types of crops which you have. Example if you have a if you have a point source now in the case of individual tress if you have a point source if this is the tree in plant.

In the case of a point source you might or the lateral and if you have the point source depending on the requirements of the tree you might have a a number of those emitters put here may be 4 of them may be 8 of them depending on what is the requirement of the particular plant and also the number can change with respect to their age, in the beginning they might require less water you can you can have less number of these emitters.

At the same time you might have another arrangement where you have instead of 1 laterals passing this tree there can be 2 laterals. In that case you can have 2 emitters on each lateral, there can be another situation where you want to use a line source for the same you have this tree you want to use the line source so in that case you might have either 1 lateral and on that

lateral you might have a segment of perforated emitter and that emitter will have these perforations. So this is the line source which is again catering to the requirement of the tree.

If 1 is not sufficient you can have another one, the 2 laterals going in 2 of these sections of perforated pipes taken care of the requirement. So there is no hard and fast rule. Similarly if you are talking of the other extreme which is the row crops so if you take the row crops now in one case I can have a row crop this is the one row of the crop, this is another row of the crop. So if I want to let us say that you have a similar situation now in one case for this row crop if I want to use the point source I can have this 1 lateral going through the row crop and having these individual emitters catering to the requirement of the total row only thing is that the spacing of the emitters will have to be adjusted in such a manner that you are you are taking care of the requirements of both the rows.

And in some cases if the rows are close enough and the requirements of the crops are not very high you can even use a single row of a single lateral (())(53:50) to 4 rows and 2 rows on this side and 2 rows on this side of the crop, at all is the function of what is the demand, what is the requirement of the crop, what is the type of the soil so many all those things you are quite aware of now that how we all all those things influence.

Similarly if you have a a row you can also use a the line source for catering to the requirements of the row crop. So these things can be used interchangeably and there is lot of flexibility which is available to the designer he has to he has to go beyond this the layout and beyond these these details only he has to go to the level of even going in for the cost benefit analysis, how much is the cost which is which he has to encore.

So when you talk of these designs you have to go to that level, you have to go to the level of the efficiencies those will of course will go through all those things the details which are the technical details and then ultimately you have to also look at the financial aspects of these designs, okay any question at this stage? Okay then we will stop here.