Micro Irrigation Engineering
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Lecture – 45
Sprinkler Irrigation System: Layout, Installation, Operation and Maintenance

Hello, participants. Now, I am starting Lecture 45 of Micro Irrigation Engineering subject. This Lecture 45 is on the topic Sprinkler Irrigation System, its layout, installation, operation and maintenance. In Lecture 44, we discussed and solved a design problem of sprinkler irrigation system. Wherein, you got various parameters. Mainly, the size of main pipeline, size of lateral pipeline, you got information about the horsepower requirement of the pump. You got number of laterals. Now, these laterals and main pipeline as well as pump is to be installed in the field. So, it requires certain principles, certain guidelines that is to be followed. So, we will discuss in this lecture about different layouts which can be followed. What are the different you know installation procedure and the operation and maintenance of sprinkler irrigation system?

In this part of the lecture, we will learn different types of possible layouts which normally occurs in the field. You can see here figure a, b, c, d, e and f. So, these are the different types of conditions which exists in the field. So, in case of a, it is running with moderate and uniform slope where the water supply is at the center. And the pump is attached with the source of water supply. And then, main pipeline is attached with the pump. Laterals are attached with the main pipeline on either side. After the irrigation is completed laterals are moved forward.

There can be different ways of operation. Here, you have seen this is a uniform slope. Means, there is a gradient. But, there is not very steep gradient kind of a thing. So, you are seeing that the contour lines were drawn where the elevation is given 100, 110, and 120. Now, it can be another point that odd number of laterals to provide a required number of operating sprinklers. So, we will be again you know there is a source of water. And, from the source of water, water is brought to the main pipeline. And, from this main pipeline, lateral is attached.

And then, lateral, it will be moving from this direction to this direction. The arrows show the direction of the movement of lateral.

So, there will be odd I mean to say the 1 3 2 4. So, this kind of arrangement it will be made to operate the sprinklers. In case of this particular layout, in this layout, the main pipeline is laid in this direction. There is a source of water. The water will be coming from the source and then, it will be given to the main pipeline. And this is also the slope condition it is given.

So, gravity pressure where the pressure gain approximate the frictional loss. And it allows running laterals downhill. So, laterals are moved. So, direction of the slopes, it is being shown. It is down the slope it is being maintained. And then whatever frictional loss it will take because the gravity flow it takes place so there will be gain in the pressure and that will be compensated with the frictional loss.

So, this is one another arrangement where we see the gravity pressure where the pressure gain takes place. And in this case, this is the, another arrangement the laterals to be placed down the slope. So, here, you can see these are the contour lines 50 to 100. We are seeing that these are the contour lines. And then this is the main pipeline and then the water is supplied. This is the main gravity pipeline which is being followed. And from there, the water is being supplied by using a booster pump in the main pipeline. And then, laterals are connected and water is applied to with the help of sprinkler and movement is taking place. So, laterals to be laid downslope to avoid the wide pressure variation caused by running the laterals upslope.

So, this kind of arrangement it is given in case of this arrangements. There could be different layouts depending on the field conditions. Now, this is another peculiar conditions you can see. Here, the contour lines are shown here. You can see this is one contour. This is the, another contour. So, it is 100 meter contour, this is 90 meter contour. But, it is not this kind of a thing, you know there is a hill and valley. Means, in this case, what is done? You are seeing here. This is your main pipeline and this is another main pipeline. And then laterals are attached with the main pipelines in this way. So, layout with 2 main, there are 2 main pipeline. This is one main pipeline. This is another main pipeline on the ridges. So, the 2

mains are put up on the ridges and then the laterals are accordingly attached so that the proper head loss can be maintained.

Then, in this another case, the layout with 2 main pipelines on the sides of the area. So, main pipeline has been placed at the 2 sides. But, field situation is something different. You can see the contour and the contours are, this is 40 meter to 100 meter. It means, the contour lines which has been done, but this is another kind of situation it happens. So, layout with the 2 main lines on the sides of the area field to avoid running lateral uphill. So, instead of taking the lateral uphill, this can be made. So, we may have to spend more but all the area it can be spend more on the length of the main pipeline which is normally large.

But, we can get water with the lower pressure when we are placing the main pipeline on the side of the field and then laterals are allowed to run in this manner. So, this is one lateral. This is another lateral. And then, the movement is taken. You can see movement of the lateral is taken this direction and this lateral will be moved in this direction.

Then, this is the, another arrangement which you have seen there. If it is a split lateral layout, same kind of your fields are there. That can be the, another way. In this layout, main and sub mains are located such that set move lateral may operate on either side of them. You can see here, a, in this case means, your movement of the lateral may be taken on either side of them. So, it could in case of this particular figure or this figure or in this figure, we can see this split lateral layout it is shown here. Means practically this type of lateral, what happen? They minimize the frictional loss because we are reducing the length of the lateral pipeline. Split layout also allow set move lateral to be rotated around the main pipeline. This is the thing you know we are bringing, moving the lateral in one direction about this particular pipeline. So, this is the movement is taken. So, this is the, another arrangement. So, you can see here. The set move to be rotated around the pipeline. So, first, we are operating here. Then, it we are operating here. So, this way the total size of the pump can be reduced.

Labor requirement is also reduced by eliminating need to move the lateral pipes back to starting from the starting point c and d. So, you can see here. This is the other means we are

eliminating the need to move the lateral pipeline. That means it has been shown in case of the layout given in c and d.

Now, commonly, we are using this kind of a situation which is also which I explained there more or less same kind of it is thing. But, here, the source of water supply is the main consideration. Their slopes were the main consideration. So, if the source of water is stationary, let us say here there is a well and then it is located at the center of the field. This is our field.

And, in the field, there is a source of well located at the field and at the center. And then, the pump will be attached here and then, the laterals are moved successively in the direction. So, this is our main pipeline and lateral is attached. On this lateral, you are seeing these are the sprinklers. And these sprinkler, each sprinkler it has got its own the diameter of coverage. So, there is certain overlap. And this overlap part already I discussed there. So, this is the direction of a movement of this lateral whereas the movement of the direction of this lateral is in the opposite direction. So, this kind of arrangement and then these laterals having a specific spacing. That is Sl and this Sl will depend upon the wind speed as well as slope of the field.

Now, there could be some situation where the stream or river is flowing. So, here the entire setup will move. Means, pump will move along with all the assembly and then irrigation is being given. So, this is what you see here. Initially the pump was at this position then it is brought to this position then it is brought to this position, Like this, you know there are different positions.

So, in a portable sprinkler system, field channel runs along the edge of the farm. This could be one system where the stream is flowing by the side of the farm. A portable pumping set, sprinkler unit and lateral extending the field are used to draw water directly from the channel and distribute it through the sprinkler. So, this is the one arrangement. So, initially, it was stationary, this is the moving case.

There are some set guidelines when we are installing a sprinkler irrigation system. Those were the arrangement for the movement of the laterals means layouts. Now, this layout or installation is to follow a specific guideline. And those guidelines are the main should be laid up and downhill. Then, it should be laid means lateral should be laid across the slope or on the contour. For multiple options, lateral options means when you have got telescopic design you may find theoretically that if farm is very long, so first few meters, few say if farm is say we are using 200 meter long system. Now, in 200 meter, first 50 meter, the pipes size because it has to handle more water, so pipe size will be large. Then, another 50 meter, you are getting another like this, you know there could be 4 pipe sizes diameter from the economic point of view.

But, what happen when this is to be done by manually? Then, too many sizes, it is gets confusion. So, it is better that lateral pipes sizes should not be more than 2 diameters. That is one part from the operational point of view. Water supplies as far as possible if it is a new area, we are thinking of then we should create our own source of water at the center of the farm so that the irrigation pipeline length can be reduced and minimized. Maybe you there is a well you are digging. Tube well you are wetting or you are putting a large water body of the pond. So, accordingly, one can decide. The layout should facilitate minimal lateral movement during crop season. So, this is another part. One should see that if we keep on moving manually, it is okay one can take care. But, if it is a tractor done arrangement or some mechanical, so, there is a likely that is crop may get damaged. So, one should see that there is a minimum lateral movement should take place and minimum difference in the number of sprinklers operating for various setups. So, this is the difference in the spacing between the pipeline, so, this should be also taken care that the spacing should not have much difference.

Booster, if we are not able to create adequate pressure at the end of the sprinkler, then in between the pipeline booster pump can be used in order to create adequate pressure. Modify the layout to apply water in different rates and amounts when the soils are of different texture. Means, suppose, it is a very large area and you may find that soils have got different textures. So, it will have different infiltration capacity. So, water application rate will be different. So, there we need to have different types of the sprinkler system, nozzle size, as well as one can modify the layout system. Mainline and sub-main line layout is key to the lateral layout. They

are key to the layout. That means we need to see that they are being taken fully considered because practically laterals are receiving water from a sub main.

If the system means it is a large system or it receives water from the main line. When the laterals run across prominent slope, mains and sub-main will normally run up and down the slope. Here, this is the, another part. So, those layouts which I was showing you, this is the one consideration. It has come from there that when laterals are to run across the slope, then these are to be put up under uphill or downhill conditions.

Now, when it is necessary to run laterals up and downhill, main lines or sub-main lines should be located on ridges. This is what in the last part in your this layout f, layout f which I was showing you that f was especially that there were 2 main pipeline which were at the adjacent means at the corner of the field both the sides of the field and then laterals were attached. So, this is the region that we need to reduce the head loss variation so that adequate pressure is made available.

A typical layout you are seeing here. This is a typical layout where the system is installed. Means, we are getting water from the source. That is a well and then it is being pumped. And if the size of the pump is very large and requirement is less, then the part of the water it is bypassed. Then, depending on the quality of water, this particular case means it is well water. So, from the sprinkler point of view, normally, filter will not be needed. But, if it is a river water or some other source, a filter may be gravity filter or the settling basin may be required at that point of time. And then, there is a main pipeline. Here, you are seeing the lateral pipeline. And then, these laterals are attached at appropriate location spacing. So, this is the normal layout which is followed.

And here, it is a solid set system. When I discussed you in the different types of the sprinkler system. So, this is a solid state system. The system is installed permanently for the whole season or for whole year. And then, these are operated simultaneously. All the laterals can be operated simultaneously or part of it can be. But, for frost control or when there is some emergency, so, pump should be able to deliver water to all the sprinkler that kind of a thing.

So, a typical installation, it can be semi-permanent. It can be portable. This already I have told you that when it is a portable when the source of water is different.

Now, the installation of sprinkler system components. The sprinkler systems are tested before installation. This means before installation, those system component should be tested and we should have full knowledge that it will work and it will give adequate pressure. It will run at this pressure so that should have the full knowledge that entire system is tested. Once the installation is done, then after installation, again, it should be tested whether it is working perfectly.

The installation should be carried out as per the suggested guidelines. So, when we are talking about the installation part, this installation consists of a head control unit, making the trenches, fitting the pipes in the trenches, attaching valves, main pipelines, sub-main pipeline, laterals, and attaching sprinkler head. All these are the part of the installation thing and this should be done looking to the field, one should do the installation.

Let us try to know these installations. So, when we are talking about the installation of the head control unit means head control unit is basically a pump and valves and then if it is a filter then we can. So, means it requires a cemented platform because pump will operate so, it will have vibration. So, it may. So, it needs to be concrete platform and it will depend upon what are the components in size and then, what kind of arrangement it is there. In case we need to apply certain chemicals, fungicide in the fruit plantation in that case chemigation unit can be also attached, and air release valves. So valves, pump, and then the chemigation unit, filter. Basically, this filter is a gravity filter or, I am telling settling basin that can be used. And then, after putting, this should be properly painted those parts so that it should not get corroded.

You can see here the trench. Normally, trench should be of the size where it will accommodate main pipeline, sub-main pipeline and if it is a portable lateral pipeline, so, this should accommodate, this should be wide enough. There should be enough depth as well as. So, normally, 45 to 70 centimeter width and 70 centimeter or 75 centimeter of depth. These are dug by using the trench maker or by using the excavator. That is a mechanically normally

it is done. But, it can be done also manually if it is a smaller area. The pipeline, normally, the pipes are HDPE make or PVC. So, these pipes are put up in the trench and that trench should be after they are put up it should be seen that there is no leakage. So, Teflon tape is used and then, these trenches are filled with the back fill material.

The valves, there are quite a good number of valves air release valves, and flow control valve these are installed and they should be also seen. One should see that they are properly fitted and then, Teflon tape is used to wrap the threaded part of these fittings so that there is no leakage from the system. The pipeline, means once whatever size of the pipeline which we have designed, so, this will be placed in the soil and these pipelines should have the adequate capacity to withstand the pressure. Once we have placed the pipeline then we should cover this pipeline with the soil surface or soil cover.

Same kind of a thing what way I have explained about the main pipeline, same thing is adapted for sub-main pipeline. This could be made up of PVC, HDPE or LDPE. So, these are of different sizes. So, this is also designed and this should be depending on the size of the pipeline and thickness of the pipeline is decided and one should follow the BIS standard. The quality pipe should be used. BIS instant pass pipe should be used so that it does not crack and it should be able to be with stand the water pressure. It should be with stand the load which is falling on the pipeline.

Then, installation of the laterals. So, laterals are also of smaller size and they are normally kept above the pipeline and, on these laterals, the riser pipelines are installed. Installation of riser pipeline, risers as well as the sprinkler head. And, below the sprinkler head, the riser pipeline it is there which is made up of GI. That is a galvanized iron. Normally, 1 inch pipeline that is a 25 millimeter dia. pipeline is used and so, this is a simply threaded part that can be done very easily.

And, these are the set of tools and equipment which are used when we are installing the system. Of course, most of the installation it is done by the dealers and supplier. But, one as a participant, we should have knowledge. What are the different equipment which are used for installation? So, a big list which I have provided so that you can use it for this purpose.

Now, these are some of the fittings. You may find water meter, is used for finding out the how much flow it is taking place, pressure gauge, elbow and how this is the 2 end, so, there is a flange, there is a coupler and, on the coupler, riser pipeline is mounted. On the riser pipeline sprinkler head has been mounted. This kind of a flange which are connecting the 2 pipes and in between these 2 pipes, the sprinkler is mounted. This is a tee and this is end cap to cut, terminate the water line. This is the coupler for joining one pipeline with the other pipeline when we want to extend the length of the pipeline.

Now, there are procedure or operational procedure one should use and these are very important. So, these are say prime mover, pump. It should have the proper alignment so that it is properly fitted and then main and lateral pipeline. Always it begin from the pump. First the pump, then from the pump side it start to lay means attaching first main pipeline then, with the main pipeline, lateral pipelines are attached and, then at appropriate location, the air release valves as well as the other valves they are fitted. Means different types of the valves which are required at different places they are fitted. So, the pipe as well as sprinkler lines are shifted as and when needed. So, when we are doing it, this is the operational part, system should be closed and then, one should shift and then, after fitting, it should be refitted likewise. So, this is the pipe fitting. So, pipe fitting, when we are putting it, the pipe should be fitted such that there is a no leakage it takes place.

Sprinkler head as already I have told you, it is fitted on the main with the riser pipeline. Only thing that make sure that it is not getting damaged and one should not use oil or grease or any lubricant. It is a water lubricated component. So, one should be careful. Otherwise, it will stop working. So, this is the important part and these are all threaded. So, did not discuss here. You may refer this thing. If there is a something that spring got loose, so, it needs tightening. So, it should be. And then, another part is that all the component they should be kept in a dry place and cool place so that the corrosion does not take place so that should be also important part. One should not keep the racks of the fertilizer bags in the same room. This may spoil the pipeline. So, this kind of a thing one should keep take care.

While we are putting the storage of the system after the use, normally it is brought back and kept it. So, this should be taken care and at appropriate location the grease, the shaft and the pumps should be checked time to time that it is working properly. We should protect the electric motor from the ingress of dust, dampness and rodents.

There are some problems while we are operating the system. And if, so, please refer these notes which I am giving here. But, just I am giving some of the point that the pump does not prime or deliver water. What could be the reason? So, check the suction pipeline and connections for air leaks where there is an air leakage takes place. So, if air is entering in the pipeline, it will not be so. It should be air tight. And then, also one should see whether foot valve whether it has got blocked. So, this could be another reason. So, all the points which I have mentioned here and this should be taken care if someone find that pump does not prime. Means, when we are doing it particularly in centrifugal pump, priming is one of the important part and then one should take care. So, check these points that the delivery pipe is fully filled with the water and then we are closing and then we are running the pump. So, this kind of thing should be taken care while we are doing it.

So, the other point is that sprinkler do not turn. So, what could be the reason? Means, whether there is an adequate pressure we are putting and if it is then check the nozzle it is not blocked. So, we need to unscrew the nozzle or check the sprinkler. Usually, it is pushed down in whether it has gone inside the riser pipeline. So, it should be rebrought. But, do not, again, it is cautioned or given that do not use oil, grease or any lubricant in the sprinkler head. This will be spoiled. It will not work. And then, we have to keep all the fittings if there are some components in some part of the washer or bottom of the bearing, so, replace, if it is worn out or damaged. So, these points one should take care while see if the sprinkler do not operate.

Then, you see that the swing arm spring tension whether it is properly tightened. If it is not, then one has to pull up the spring by more than about 6 millimeter. Leakage from the coupler or fitting, this is a clear cut if it is like this. So, one has to open and refit and then put use the Teflon thing. If it is worn out, replace the component and then, take care that part because leakage part it is very clearly visible. So, this can be seen and so that the water does not get

lost as it is a valuable resource. And then, the purpose of using sprinkler system will be lost if a lot of leakage of water takes place from the couplers and fittings.

So, for this particular topic, it is very nicely well discussed about the different types of troubleshooting in this particular reference and then for the layouts, one can refer the Principles of Farm Irrigation System Design by using L G James. And there are other references, which is available in the net that can be also seen. This is another book by Christiansen J E. This book is also available in the net. You can see.

So, in this lecture, we discussed about different types of layouts and their guideline. We also discussed about operational and maintenance guideline. We discussed about the troubleshooting required while we are operating the sprinkler system. So, how to maintain the system? Now, in coming class, we will discuss about standardization and quality experience of micro irrigation system components. Thank you very much.