Micro Irrigation Engineering
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Lecture - 46
Standards and Quality Assurance of MIS Components

Welcome participants, I invite you to the lecture 46 of micro irrigation engineering subject. Lecture 46 is on standards and quality assurance of micro irrigation system components. In this lecture, we will be mainly covering topics on testing of materials and then the different types of test involved. And then what are the different standards of micro irrigation system components and their testing. And then what are the different IS codes, which are used for different components of MI systems.

Now, what is testing and how testing is carried out? So, concept of testing is an integral part of research and development, product design, manufacturing, means once we are developing any product, we should see that this product does it fulfil the requirement? What is the life of the particular product? How effective this product is? How much the range of the specified boundaries it can undergo? So, this is a very important part of the testing.

And, then test can be carried out from the small specimen not for the entire product. Let us say that, we are developing a dripper. So, randomly from the thousands of dripper only 25 numbers of a specimen can be taken for a test, and then one can come out with the whether does it satisfy the particular criteria. So, these tests can be non-destructive type of test or destructive type of test. So, non-destructive test normally it is, preferred because we are not disturbing, not destroying the product, that product can be used so naturally it is expensive. So, what I am telling here, this non-destructive tests are expensive as compared to destructive test, and it uses ultrasonic and radiographic method which are advanced non-destructive test. Why we carry out test to prove design concept, to prove basics for reliability. How reliable a particular product is? To look for the safety point of view, there are some certain product which has been made, whether it is safe to use and safety precautions has been it is following, and then protection

against the product liability, quality control, to meet standards and specification, to verify manufacturing process, to evaluate competitors product which are available other product of same nature, and to establish a history for new material. So, these are the purposes for which test is being carried out.

These tests could be of a different means analytical test, they can be material characterization test, and they can be material property test these could be of using the product test. The purpose of analytical test to test the quality control, to develop a new product, to design the product, to optimize the process or when we are doing analytical test, we need to make the test for the density, we need to make test for the specific gravity. Of course, it will depend upon the particular type of product. It could be the moisture analysis, it could be the water absorption point of view, and it could be from the sieve analysis point of view.

When we talk of the material characterization test, it is basically carried out to identify the material, to find out the chemical composition, to find out what is the structural characteristic, to find out the flow behaviour, if it is a plastic material mainly from the plastic point of view. So, we try to know that what kind of test it is to be carried out. So, means flow point of view. So, we will be characterizing these material characterization tests by having the material flow or by using the test for viscosity, molecular weight distribution, and thermal properties. Then spectroscopy, microscopy, these are the other things.

And then material property test; basically there are various properties which are required to be tested at per the prescription made by the American society of testing material that ASTM or ISO. There are some many other properties which are used for the testing of the material. So, these properties could be of mechanical behaviour, thermal behaviour that is thermal property, from the electrical behaviour electric property we will be testing. How opaque this material is? How the optical property? It is varying from the weathering point of view. How fast it is getting weathered or it is getting deteriorated, so weathering process and chemical properties. So, these are the properties which are used for testing.

There are several organizations, which are available in the world. These organization basically they formulate the guideline for a particular type of material. Now with respect to your micro irrigation, with respect to sprinkler irrigation system, there are different agencies for the different components of these things. So, these agencies they look for the standardization. So, one is ISO, that is international organization for standardization. The head office is located at Switzerland and then the international electrochemical property. So, this is a chemical commission that is related to electrical field. Now, with respect to agricultural and food material, these are the agency they look for their property testing material. That is the bureau of Indian standard, then there is a British standard institute, American society for testing material ASTM, and then ISO and then American society of agricultural engineers. Now this particular society's name has been changed to American society of agricultural and biological engineers ASABE and then American nationally standard institute these are the ANSI. So, these are the some of the organization they are bringing out different specification and test procedures. So, that the testing can be carried out.

So, with respect to micro irrigation component standards and then these are the indicators performance indicator which will be tested and bring out the particular value. So, one of the important thing from the micro irrigation component point of view, because these are made up of plastics. So, an important characteristic to measure the melt flow index. So, there is a machine which is used the right composition of material and then the composition of material will describe that, this should be the value of melt flow index for a particular material, plastic material. So, a tensile strength is normally it is a tested by using the universal testing machine and indeed it gives a strength of the material and elongations shows the extension of the material under load.

So, your specimen is kept at this particular point and then, they are stretched. So, this is the thing and then load there is a load indicator, how much load we are giving exactly and so, this test is carried out for a special shaped piece obtained by dumbbell and then elongation is measured at

27 degrees temperature. And, then the value is obtained and then for a specific product, this value is fixed. So, accordingly the tensile strength is measured.

Then environmental stress cracking resistance, this indicates the strength of the material against breakage of various environmental conditions. So, a water bath with thermostatic control, vernier callipers that is used for measuring the thickness as well as the elongation how much it takes place, ball ended micro meter, forced air circulation oven. And, these are the devices which are used for this environmental stress cracking resistance.

The reversion test to find out the internal stress during process of the lateral pipeline. A pipe of about 200 meter long is subjected to a temperature of 100 degree Celsius for about an hour and cooling to the room temperature is brought in a shorter period and dimensional changes, if it takes changes, it should be within the three percentages. So, this is the reversion test and this particular device is reversion tester oil bath. So, this device is used for measuring the reversion test. And, then thermostatic oven is that instrument which is used for this test. Carbon black content, this is another important thing and particularly for finding out the appropriate stability of the ultraviolet stabilization. So, carbon black concentration is essential to ascertain the lateral can provide appropriate UV stability.

Lateral that is a lateral pipeline, so black carbon is added in the pipeline in a specific amount. So, this should have a specific supplied density when carbon is being added, and it should be means to the extent of about 10%. So, to know the black carbon content in the particular material, when we are adding this is by using the carbon content analyser is used and with the pure nitrogen cylinder is used to measure the black carbon content.

Then carbon dispersion is another property and that is also studied. So, here the carbon dispersion test is made to know the good UV stability of the lateral pipeline. A device known a microscope with the magnifier of 200 times is used to find out the, how much carbon dispersion it has taken place and it should be also within the prescribed value. So, hydraulic characteristics,

it is the internal pressure creep rupture of the poly tube. That is conducted to know the hydraulic characteristics. Acceptance test lower temperature of for a small test duration of about one hour is conducted. Quality test higher temperature with the longer duration of about say 100 hours to stand the specified induced stress of 22.5 mega Pascal and 20 degree Celsius for one hour at induced stress of 6.9 mega Pascal is used. So, this is for pressure creep rupture tester.

So, these tests are important and when we want to know the longevity means instead of waiting for one year, two year or five year then how the deterioration it is taking place in a short period, in minutes or in hours, when a particular compound and the particular specimen is kept for a duration. Then such test give the value that what will be the longevity of the particular component.

Now, these are the some of the standards of the various components, which had been prescribed and this should follow the test values prescribed by the ISO. As per the BIS standard for main pipeline and sub-main pipeline of drip irrigation system it should have means, the standards which have been prescribed for PVC pipe. It should follow the standard IS 4985 2000 and for HDPE pipeline IS 4984 1995. For lateral pipeline of 12 millimetre and 16 millimetre, this is the particular standard type have been specified. Emitting pipe system, emitters or drippers which are pressure compensating or non-pressure compensating, there is been a particular specification, it has been given, micro tube, micro sprayers so, these specifications have been already specified and we should pass through this test.

And, then another important component for the drip irrigation system, where we are telling all the time that is dripper should have clogging free. And, then to remove the suspended impurities in the water we use filters. So, filters should also pass through some certain specifications which are specified by the bureau of Indian standards and these are the number for strainer filter IS 12785 for medium filter, hydro cyclone filter, this particular number is given. Then fertilizer applicator, that is your fertigation equipment for this also, the specification has been given. And, for pressurized irrigation equipment and then terminology, it has been given. In this particular

installation guidelines and recommendation criteria for adoptability of different irrigation methods. Irrigation components that have also been given. So prevention and treatment of blockage problem in drip irrigation system and their component practices, these are also specified.

Now, the standards which I gave say for drip lateral. Drip lateral it is made up of polyethylene. Normally these are drip lateral these are made up of LDPE, LLDPE and then it should be withstand internal pressure creep rupture test at the temperature of 70 degree Celsius for 100 hour at induced pressure of 2.5 mega Pascal at 20 degree Celsius per 1 hour and induced stress of 6.9 mega Pascal. So, this is the range of the pressure which has been suggested for testing the deep lateral pipeline and this is the specification. Maximum longitudinal reversion of pipe after keeping it at temperature of 100 degree plus minus 2 degree Celsius for 1 hour shall be, so whatever elongation or shrinkage, it should be within the range of 3% this is the recommended thing. The tensile strength and resistance to internal pressure are major properties to be tested for laterals. And tensile strength at break, this is the test range means 27 degree plus minus 2 degree Celsius and test speed of 100 millimetre per minute, and then plus minus 10 mm per minute, P should not be less than 10 mega Pascal. So, this is for finding out the tensile strength. So, UTM which I was telling that universal test machine, we need to apply this kind of test by giving this much of pressure.

Then pipe shall withstand the accelerated test for susceptibility to environment stress cracking, and so in a short period when we are giving such things. This will be useful for a longer duration, study one can know in before when the in the laboratory conditions, when tensile strength or melt flow index, this should be one should make it done. So, that these are properly understood that it is working.

So, emitting pipe, these are the lateral pipeline, but pipe itself, it is an emitting water. So, here also means this particular code the particular emitters or emission pipeline, it is given that when you are collecting discharge, this discharge should be within, variation should be not more than

plus minus 5%. So, if it is falling within plus minus 5%, we are putting such pipelines as category A, that is a very good category we can say. And then, if it exceeds it means, if it exceeds 5% but within the 10% plus minus, then it is brought under category B pipeline and if it goes beyond this value, it means such pipelines should not be used for drip irrigation purpose. Because this will, what will happen? This will not meet the requirement and basic purpose of using drip irrigation system will not serve. Emitting pipe cell withstand hydrostatic pressure of 1.8 times. And recommended working pressure at ambient temperature of 1 hour and temperature of 60 plus minus 2 degree Celsius for 48 hours. So, this is another, that what is the hydrostatic pressure, it should be the stand. The emitting pipe cell also bear the tensile strength, this is the hydrostatic pressure means when water is flowing, and this is the tensile strength when it is under certain tension of the pipe. So, it should be 180 Newton. So, it should bear the tensile force of 180 Newton for 15 minutes at elevated temperature of 50 plus minus 2 degree Celsius.

So, joined between fittings, this is the part we say particularly when the temperature goes very high, say in case of during summer month, in case of Rajasthan field conditions where the drip line is laid in sandy soil. So, this kind of situation will happen, so this should be tested before it is fitted that whether it passes through the tensile strength. Then the emitting pipe shall bear the pull of 180 Newton for 1 hour, this is another condition.

Then, main and sub main pipeline this is the IS code, it has been specified for the PVC and this is for HDPE and BIS specification for the plastic materials here. The PVC pipe base material the density is from 1.40 to 1.46 gram with the K value of minimum 64. For high density material, the base material density should be in this range that is 0.9405 to 0.9460 gram per cc, and then melt flow index is also given 0.4 to 1.1 gram per 10 minute at 190 degree Celsius per 5 kg load. So, these are the specified values and that should be tested. Carbon black should be tested similarly the extrusion is carried out under strict quality control condition to ensure that the internal and external diameters are remain within the specified tolerance. Short term hydraulic test is to be conducted to detect the manufacturing defect periodically, and the long term hydraulic test to

assess the durability of the pipeline. So, it means the pipe should be withstanding the hydraulic resistance, it should be withstand the tensile part and it should withstand the black carbon.

Emitters, which just now when we are talking about, this is the smallest component and this is very important component of the micro irrigation system. So, smallest measured flow path dimension and then the dimension declared by the manufacturer that what is the size of the orifice from which the water is appearing. So, if it is a micro tube there will be one dimension and if it is a very fine and the tape by wall kind of system. There it will have a different dimension. So, emitters shall be tested to resistance to hydraulic pressure and leakage at pressure twice the maximum working pressure. Mean emission rate of 25 randomly selected emitter shall not deviate from nominal discharge rate and that should be within the not more than 5% for the category A, and not more than 10% for the category B, plus minus 10% for the category B.
So, these are the two ranges which has been given, if it exceeds more than the means 10%, then the dripper should be rejected and then the new dimensions or new dripper should be developed or used. Micro tube it has got another code and this would follow that it should confirm the requirement for this longitudinal reversion, the tensile strength and environmental stress cracking for the small polyethylene tubing's. Because micro tube is the polyethylene tube, this is also made up of LDPE or LLDPE. It should be withstand hydraulic hydrostatic pressure 1.2 times the maximum or operating pressure when, what we are operating the different pipeline.

And for different material, for different materials say PVC pipeline, HDPE pipeline, LDPE pipeline, LLDPE pipeline and these are the different material or property characteristics and these are the prescribed values. So, these product what we are doing with this pipeline which is being developed it should follow in this range. Means density in this range, K value it should be minimum 64, then manufacturing melt flow index, it should be in this range like this for different pipeline, PVC, LDPE or LLDPE and these are the prescribed values and one this would be used.

Micro sprayers is another device which is used in the drip irrigation system; micro irrigation system. So, it should bear the hydraulic pressure 1.2 times the maximum working pressure for a

period of 1 hour threaded connections shall be the strength, torque of 20 Newton meter. This much that is the pressure which should be applied. In uniformity of flow rate should be plus minus 10% and regulated sprayer plus minus 7% for non-regulated sprayers. So, regulating micro sprinklers, micro sprayers deviation in maximum and minimum of regulation range should be plus minus 10% and average value should be within the range of plus minus 2.5% of the nominal flow rate. Then the diameter of coverage that is the water is sprayed in a diameter and so this would be within plus minus 10% of the manufacturer's value. After the operating the micro sprayer for 1500 hours measure the flow rate and then we should find out how much variation it takes place.

Strainer filter, it should follow this particular guideline and these are the setup the values, which has been recommended, it should means the filter element should not undergo the buckling or tearing pressure. So, it should be test, undergo these test and then the clean pressure drop, it should be less than 10% of the pressure prescribed by the manufacturer media filter, means whatever the strainer it has got it should follow. And then guideline for setting the media for the preparation of the bed, it should be there. And, then the sand which is used it should be graded sand and it will pass through the 10% of the sample of the sand, then coefficient of uniformity Cu, that is given by ah D60 by D10, that is the diameter of the particles which are which passes through the 60% and then the diameter, D10 this ratio through the same, then we will this ratio should be within the range of 1.4 to 1.6.

These are the recommended flow rate for the media filters depending on the contaminant available in the water suspended material available in the water if the contaminant is between 0 to 10 milligram per litter, then the flow rate recommended is 63 cubic meter per hour per square meter of the surface area of the filter, media filter. Similarly for other, if it is a heavy then the flow rate will reduce that is 43 to 50 cubic meter per hour when the contaminant available in the water is 101 to 400 ppm level.

Venturi injector, this is for the fertigation, this is the IS specification which has been recommended. So, where the motive flow water suction rate of the test liquid should not vary more than plus minus 10% from the declared value and minimum pressure drop as far as possible it should have so that the head loss due to friction, a head loss from the system of the fertigation system, it should be within the prescribed limit. There are code of practices, which are used for design and operation of the field evaluation of micro irrigation system. So, these standards should be made in terms of coefficient of variation, emission uniformity, and allowable pressure variation, what is the filtration requirement and then what is the chemical water treatment, fertilizer system, injection system, flow monitoring etcetera. So, there are set of the guidelines, which had been defined in this case.

So, we can see here from the coefficient of variation point of view and if we are using the point source emitter then Cv range, the range of the Cv it is given and if here what we see the coefficient of variation means the discharge which has been collected from the set of the drippers and if there discharges, Cv is less than 0.05 it is a such drippers are of excellent category.

Now like these values, Cv values are given and it is a poor category say 0.11 to 0.15 for the point source emitter. For the line source emitter and the greater than 0.2 is marginal and less than 0.1 is good. And if it is going more than greater than 0.2 marginal are here in case of it is a poor, we should not select it, we should simply reject that a lot and then ask for the new product so that the good uniform emission uniformity we can get. And, then recommended range of the design uniformity for the point source on the perennial crop, the crop spacing is greater than 4 and it is laid in this type of slope less than 2%, greater 2% then what we see that the emission uniformity should be in this range i.e. 85 to 95%, it should be, if it is not then we have to make the changes in the design. Similarly, for other condition. These are the topographical condition and these values are there, so this particular table is a guideline and this should be tested and it should fall in this range.

Similarly, for the clogging problem, so code of practices for prevention and treatment of the blockage problem in duplication system, and this is a serious problem in replication system particularly from the suspended solid point of view, because it clogs the system, the efficiency of the system get affected. So, this should be taken a due care while we are operating the drip irrigation system, so that the blockage problem can be prevented. So, standard covers recommendation for testing of quality of irrigation water and then the chemical treatment devices, what is the cause of the blockage, method of assessment. These things should be, so it should, it also covers the recommended dose of chlorine and treatment. So, this is the code which has been prescribed that is IS 14791 is the specific, there it has been given and one should follow and read these things and this water should follow this practice.

So, to get more detail you are advised to go three through these references and there are standard books and also there are BIS standards, which I have mentioned there in the discussion. So, go through in detail. We are summarizing the in this particular lecture, we discussed about the different types of test. The test to be used for MI components, what is the standard, Indian standard formulated test for the micro irrigation components, code of practices for design, installation, operation, field evolution of micro irrigation system. Now in the forthcoming class we will also study the standards and quality assurance of sprinkler irrigation system components. So, thank you very much for your patience hearing.