Sustainable and Affordable Sanitation Solutions for Small Towns
Prof. N C Narayanan
Centre for Technology Alternatives for Rural Areas
Indian Institute of Technology, Bombay

Lecture – 18
Decentralized Waste Water Treatment system – an Introduction

So, as NC said that this whole thing of DEWATS, I first say little bit about DEWATS as in about how this whole thing came about.

(Refer Slide Time: 00:27)

Actually DEWATS actually stands for Decentralized Waste Water Treatment Systems and it is actually a registered trade name or something right now. So, what as we all know that I mean we all started working in the field of sanitation since early 90s I finished my course in 1990. And, since then and it is sad to say that even now two and a half decades later we are still probably struggling with the same basic issues even though our country might have lead forward in so many other sectors.

(Refer Slide Time: 00:59)

It is little sad that even now about 90 percent or so, of our towns and cities do not have any proper waste collection or management system be it liquid waste or solid waste and so, therefore, we all know the related issues of water borne diseases and all the related thing I do not have to go into details about it.

So, this whole there was step towards trying to go for better sanitation as always been trying to explore what is the possibility. So, over the years I think there has been several models that have been tried out and demonstrated and a kind of multiplied in several parts. Right now because of the Swatch Bharat mission and all that there is a much more stronger thrust on trying to make India totally open-defecation free and all that.

Thing is that to a certain extent we are able to tackle the containment that is we are able to do the toilets and kind of containing it taking it one step away from above from open air defecation, but that actually is creating a whole lot of new challenges. In fact, right now we are as working with a village in rural Madhya Pradesh where actually people were, it is a small village it is just about 20000 people or something and they have been. So, there they have lot of fields around and all that and everyone has being used to open air defecation for a long time. But, thing is that now as part of the Swatch Bharat they have been given toilets.

But, the toilets when they have been they are not if you are not giving enough thought to what is the treatment happening then that is where the problem gets stuck. So, they all

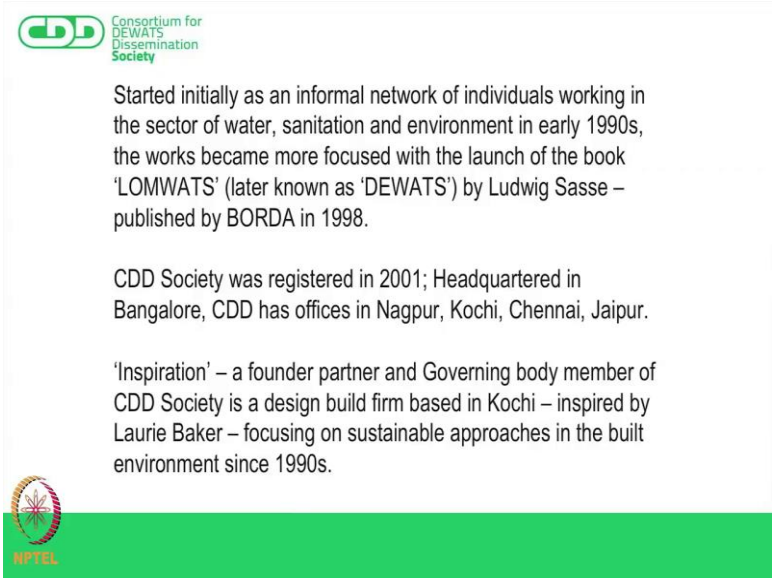
have these leach pits which are provided which has got filled up in 6 months time. So, what do you do with the waste that is accumulated in it; so, that is the next challenge. So, you are actually trying to solve a problem, but you are creating a whole lot of new challenges in another way actually; so, just keeping that in mind.

(Refer Slide Time: 02:53)

So, what how DEWATS started is that they were quite a few of us about 7 or 8 of us in different parts of India who were all working in decentralized sanitation and water and related issues in our own ways and this was if you know it was like the pre-internet and pre Google times actually. So, the only way that we were probably keeping communication was through either journals or books or like personal contacts and all that, but finally, that happened actually.

So, it was at that time that this whole concept of whether it is possible to do a decentralized waste water treatment system actually began probably took routes in India. And, the initial systems that we were talking about were things like aquatic weeds lagooning and all that like using duckweed for waste water treatment and small-small experiments like that.

(Refer Slide Time: 03:47)



There were biogas plants and all of course, but the whole experiment actually started getting a little more thrust in early 90s where there is this architect called Ludwig Sasse was based out of Germany who has been working for a worked in for many years in China on biogas plants and then he moved to India also. He actually taking off from his research in biogas plants he came to the very strong conclusion that actually for tropical climates like India, anaerobic treatment systems are much more relevant.

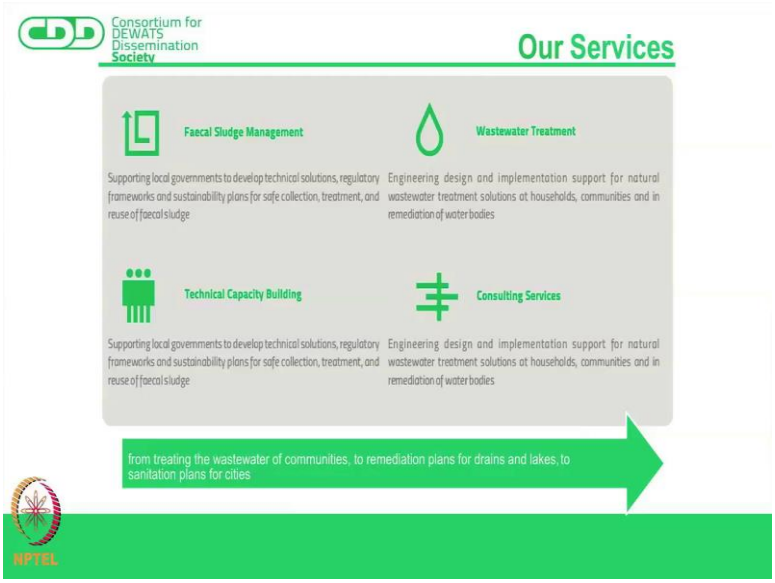
I am sure all of you know the difference between aerobic and anaerobic treatment now that, I am not going into it, but that was one major kind of an into kind of a research that made the way for the next whole set of work that happened actually. So, he wrote this book which was published in 1998 which was initially called the LOMWATS, but later on the publications are called DEWATS actually. It is a publication by CDD I think any of you can actually order the book. It is like a I find that still probably the easiest kind of a handbook to understand all the aspects of decentralized based water treatment system.

So, with that I think the whole work that we were all doing in different parts kind of became a little more kind of streamlined and then under BORDA initially; BORDA stands for Bremen Overseas Research and Development Agency which was the Germany based group who actually brought together brought Ludwig Sasse, brought all of us together and then we registered as a society in 2001. Today, CDD has over 20 individuals and institutional members and we work in different parts of the country and

we have kind of spread our work even to different other parts of the world and it has offices, we right now have a small office in Cochin; there is an office in Nagpur, Chennai and Jaipur.

And as an since I mean inspiration of the small firm that I am part of was actually the one of the founding members of CDD and ours is a practice which actually focuses I think many of you might have heard of the name Laurie Baker who is kind of like a legendary architect who kind of inspired all of us when we were in college or trying to really be responsible in our profession actually. So, our journey into the whole thing of water and waste water and all that was like a continuum of the architecture that we practice which is trying to be more responsible and sustainable and eco friendly and all.

(Refer Slide Time: 06:07)

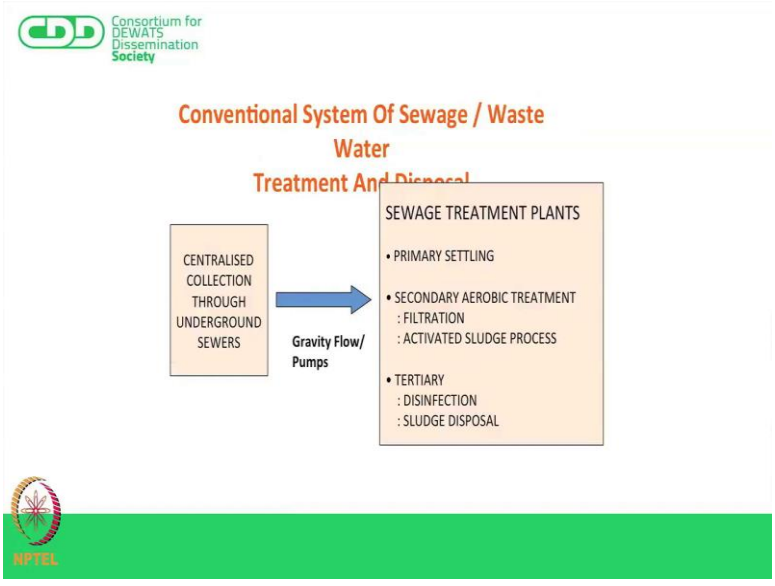


So, today the main the works that CDD does focuses on actually implementing the decentralized waste water systems. We have also taken it the next level of trying to address the faecal sludge which I said little early if you have. These are dry system then faecal sludge management is also very important part of it then this whole thing of capacity building is also being addressed to and we also now have started looking into the whole issue of urban waste water rejuvenation which I will come to and I talk about Alleppey.

(Refer Slide Time: 06:33)

So, this is just to say that how we are working; so, just getting into it. So, just to kind of say is to recap like what exactly why do we really need a decentralized approach to waste water. We all know that centralized the conventional thing that we all learn in college and we are all kind of used to see.

(Refer Slide Time: 06:55)



And, they all of are decision makers are also used to is the centralized sewerage networks and centralized waste treatment plants.

(Refer Slide Time: 06:59)

Now, why are these often impractical for a country like India we all know. One is that of course, you need to lay these very extensive large sewer pipes which. I think many of you might be North India where probably the water treatment is not of an issue, but if you are talking about places like Kerala I mean coastal Kerala and all that when you actually go round to about 2 feet that is 60 centimeter you are already hitting the ground water and then imagine laying pipes in one in hundred slope because that is what you need if you want to transport your solids and liquids in through the water and then you can never take it by gravity.

I was just telling and see today that even if you are having a pump chamber at every kilometer it means that you have to go 10 meters down to actually get your connection and you did a minimum pumping volume, it is really not workable actually otherwise we will have to have pumping stations at every 200, 300 meters and who is going to get off manage all these things, where is the power supply going to come to kind of continuously run and operate these pumps.

So, this is where the and so, it may be for all these kind of centralized systems more than 50 or 60 percent of the cost goes into this whole laying the sewers and the operating expenditure is also extremely high. So, and the other thing is about getting land which again is a huge challenge particularly for places like Kerala because where land is really

kind of expensive. So, how do you actually get the land to kind of set up a centralized sewage treatment plant.

And, then is it really the people have stared protesting also because you do not want a cities whole waste water to be dumped into a village area and they may not really want it and you are not actually balancing the nutrient cycle also. You are kind of taking all the nutrients from a big city area kind of dumping it into one area which kind of imbalances both the places. So, due to all these various reasons, so, again yeah this is what I said.

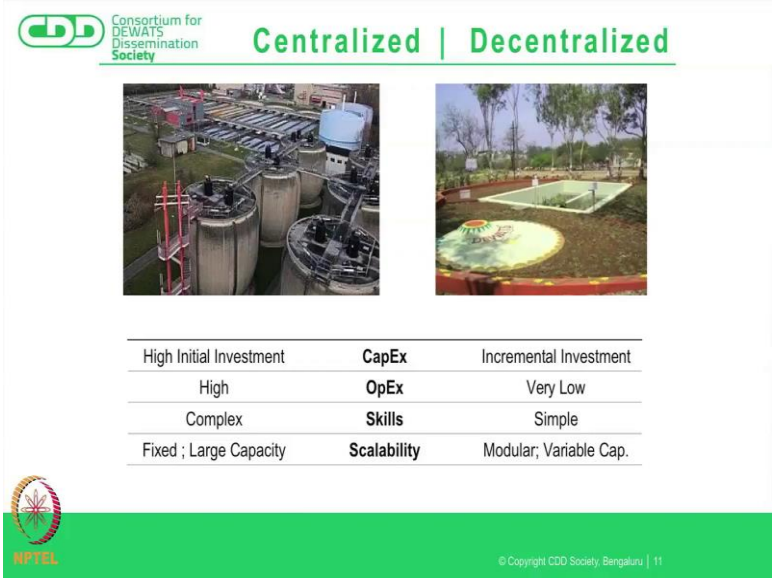
So, the so, all these impracticalities was probably why these kind of systems have not been probably set up in many of particularly the smaller towns and all that where it is where people whether civic administration does not even have money to set up such as such a thing that you do not think of operating and maintaining it for next year. And, the other major disadvantage about centralized system is that there is no flexibility in terms of how the city grows actually because there is always a limit to kind of the planners to decide which part of the city is kind of grow and all.

So, even in many of the bigger cities where you have sewage networks it is often found that where the lines are there probably the development is not happening, where the development is happening probably it is probably very difficult to kind of connected to the existing lines and all that. So, there are lot of grey spots or areas which never get connected.

(Refer Slide Time: 09:45)

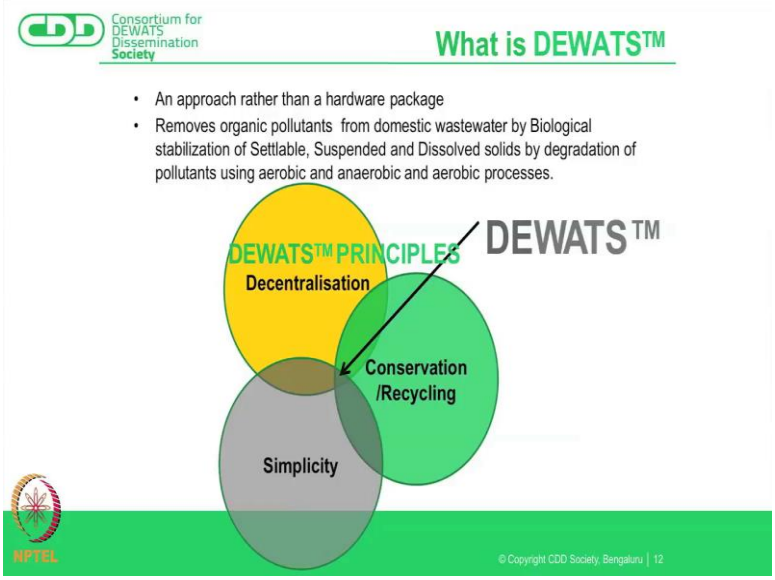
So, that is why I think over the last 25 – 30 years particularly with the research of Sasse and others in the field of anaerobic treatment. There has been a lot of research happening on decentralised waste water treatment systems and decentralised therefore, means more focused on anaerobic systems. So, the advantage are of course, are that you can decentralise it to even single household level. You can still treat it to CPCB discharge standards. They are often operable with minimum or semi-skilled or unskilled labor. Hardly any mechanical parts and comparable capital because but the operation cost are very very low.

(Refer Slide Time: 10:13)



So, those are probably the winning aspect. So, this is again this kind of same to same things.

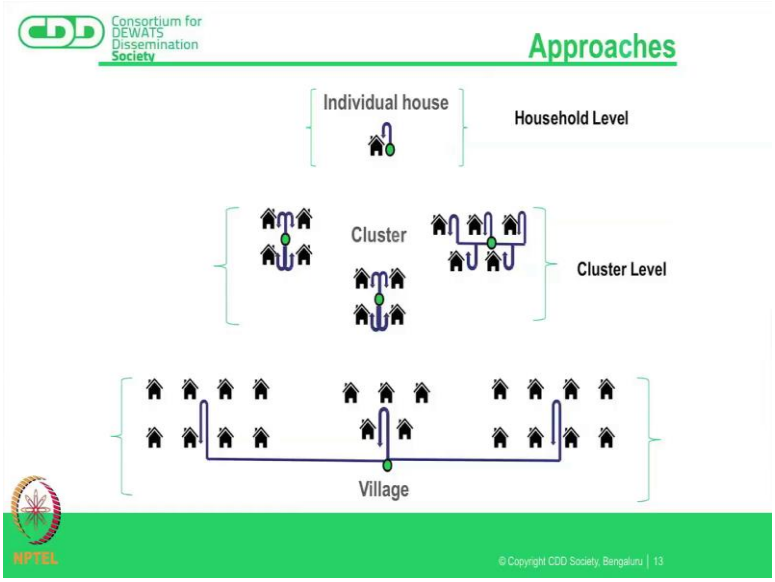
(Refer Slide Time: 10:25)



So, what exactly is DEWATS? So, DEWATS is not really like one technology that you can take across the board and apply in every state, we call it as rather an approach actually. So, it is basically the philosophy you are trying to understand how you can actually treat waste water on the site or as close to the place of generation through biological passive means.

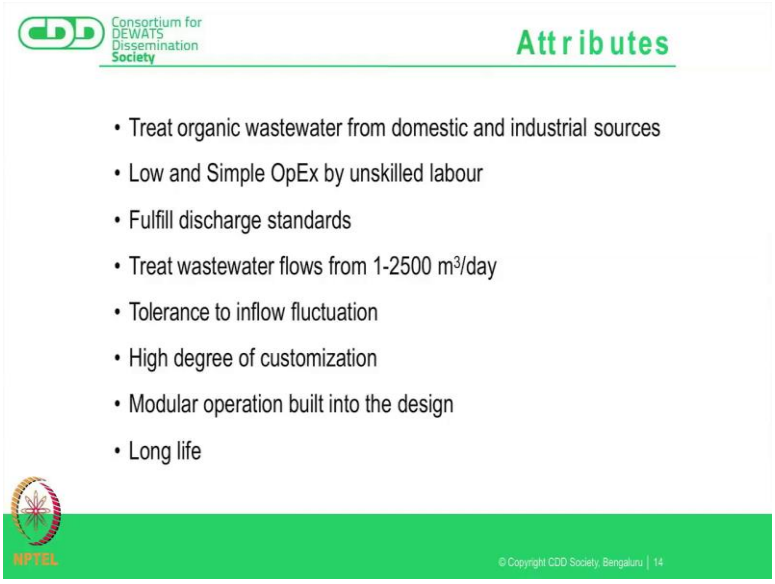
And, the treatment process is a combination predominately of an aerobic, but there is also some bit of aerobic treatment of course, happening and sometime anoxic also which happening. So, totally the whole concept of DEWATS is actually if you try to call it as a DEWATS approach.

(Refer Slide Time: 11:05)



So, I said again that you can start from as minimum as a single household then you can combine a cluster of 10 or 15 houses and have a cluster level systems or you can have like a simplified sewer system and have it for a cluster level. So, basically we always try and say that more than taking about 1 MLD or so, no longer becomes like a DEWATS system. So, we always try and break it into smaller systems, so that they are each they are smaller modular systems which can be managed easily.

(Refer Slide Time: 11:39)



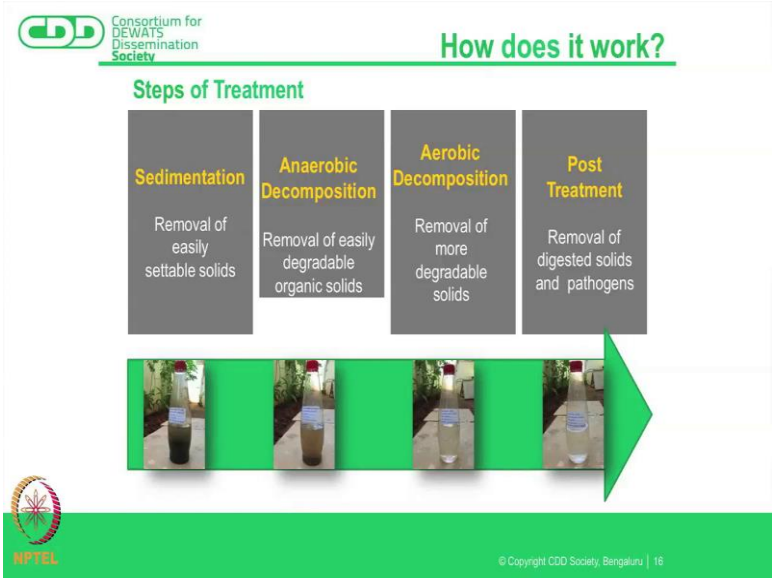
And, DEWATS can actually treat domestic and industrial sources to a certain extent not all kinds of industrial waters I think have been it is possible to do through purely DEWATS systems I do not, but a great degree of small industries which a predominantly can be reduced to biological systems can be tackled. As I said very low simple opex all these things and they can treat from 1-2500 meter cube per day.

There is a lot of tolerance to inflow fluctuation or something that we have realized through years of working and there is a high degree of customization that has possible that I said and modular. All these things have been repeated yeah.

(Refer Slide Time: 12:19)

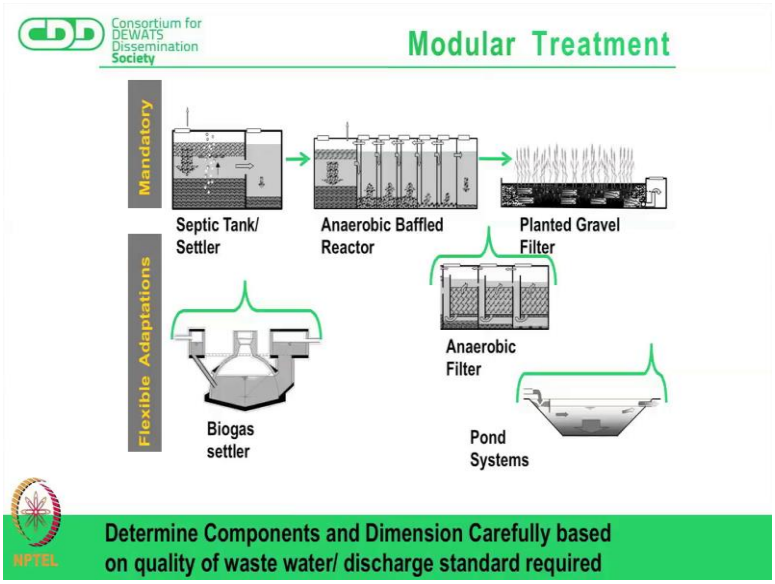
So, the applications range from housing, houses to housing colonies, apartments, hotels, schools, offices and campuses. So, it is kind of trying to see the city as smaller units. You do not really have to take all the water to one place, but whether you can actually treat the waste water as much as possible at the source. So, it can be for any of these applications is what is then.

(Refer Slide Time: 12:43)



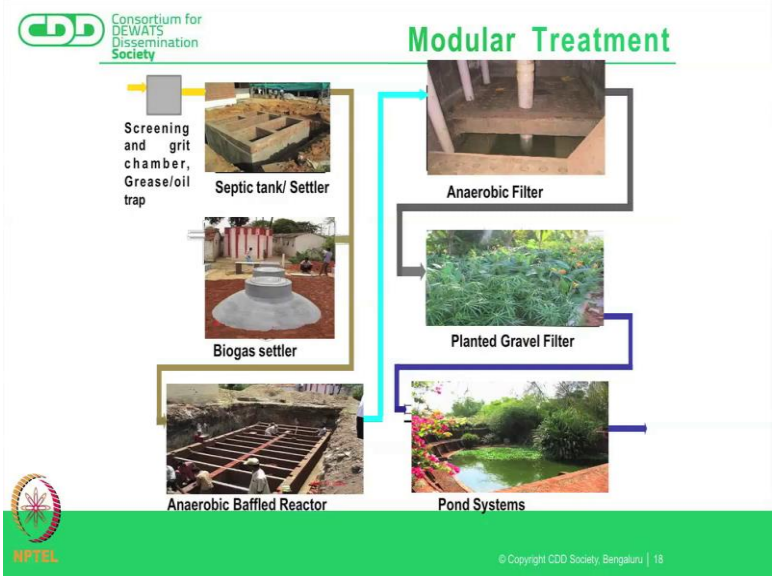
So, what is the basic principles of DEWATS? So, again as we know the fundamental need for any waste water treatment system. So, the first step was actually sedimentation because you need your when you have your shit and the water everything coming together you first module is often a settling where. So, basically the different steps in DEWATS one is of course, the sedimentation and then you have the anaerobic decomposition that is the second part of it. I just come to each of these modules actually. So, these are the basic modules of DEWATS. So, I will just start with each of these.

(Refer Slide Time: 13:25)



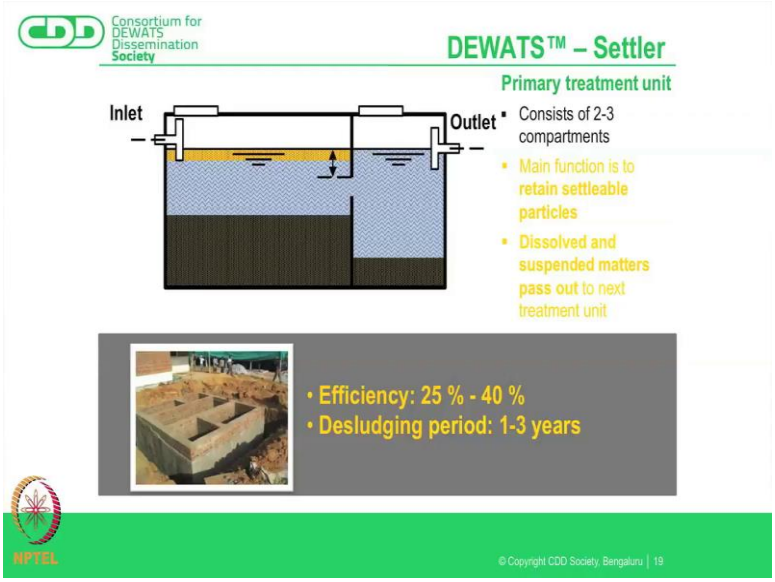
So, basically the first treatment module in DEWATS is something that you are familiar with which we all generally called the septic tank or it can be called as a settler.

(Refer Slide Time: 13:31)



So, what exactly happens here is which is something that I think in India almost every house or every building mandatorily has like a septic tank is it not so? So, what happens in a septic tank or a settler essentially is that you have your solids, liquids everything coming together and you separate out the settlable solids and there is also you can you normally your settler has about at least two chambers, sometimes you give three chambers also. So, what happens is that you have bigger solids actually settle in the first chamber.

(Refer Slide Time: 14:09)



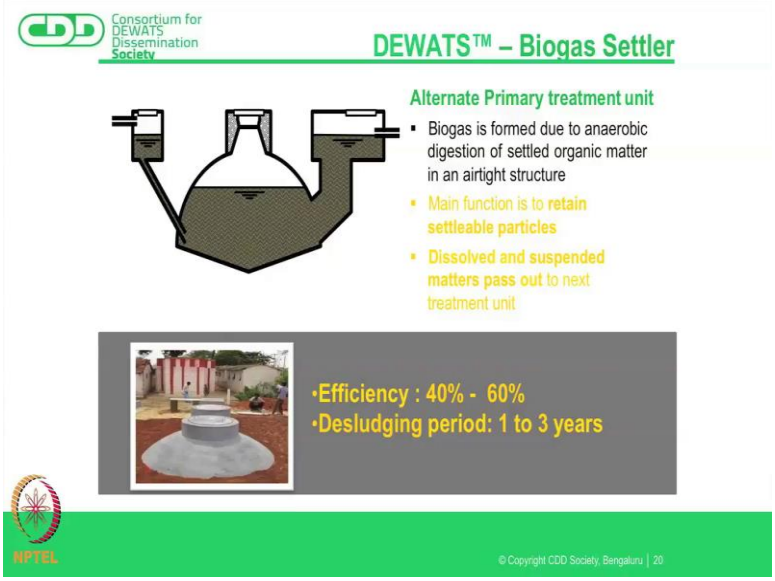
And, the connection between the first and the first and the second chamber is somewhere in the middle, so that you have the floating matter is also arrested your sludge is also separated and then you have the more of the suspended solids and bit of a sludge going into your next chamber.

So, essentially a settler or the septic tank actually probably treats gives you a treatment efficiency of only about 25 to 30 percent because essentially what is happening is only high degree of settling that is happening. And, there will be some amount of anaerobic reaction happening in this first chamber because the sludge there is already overtime it becomes active anaerobic sludge. So, there is some degree of an aerobics, but basically a the treatment efficiency of a settler or a septic tanks considered as 25 to maximum about 40 percent and you normally design the settler or septic tank for a period of about 1 to 3 years desludging time.

So, now, I do not know about in generally in Kerala and all that or in many of the South Indian place at least we know that we give a septic tank that is followed by a soak pit. So, what actually happens is that after a septic tank you actually let is percolate into the ground. Now, this is as long as your water table is very low and your density of development is very very low also. So, as and if you have a good piped water supply because what happens is that when you are actually relying on the soil bacteria to actually do the rest of the treatment from this 25 to whatever it was happening, but, when

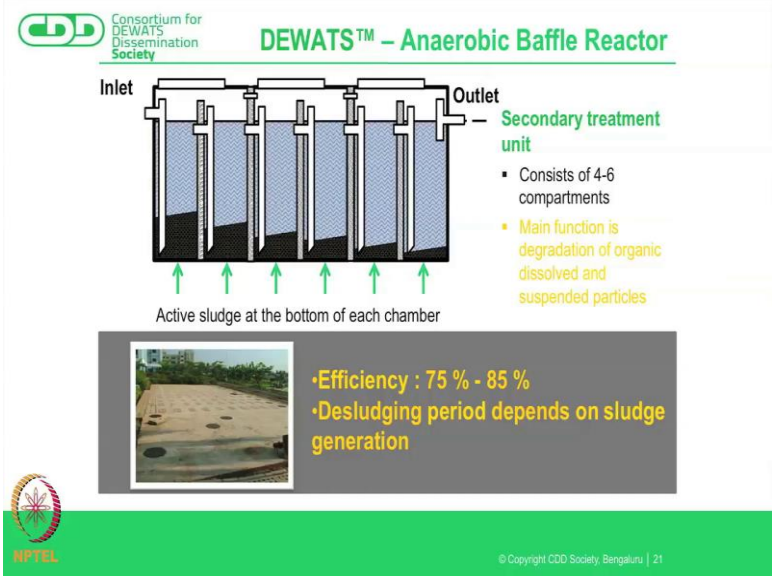
it comes to a case of very high density development combined with high water table and the lack of piped water supply what is happening is that this 25 – 30 percent treated water is directly going and contaminating your ground water or your surface water or your and along with your soil also. So, that is why you can never consider that unless it is like a very sparsely located place where you have just like one house and may be some 50 meters later you have something some other house and your soil is very good may be the system might still work, but it does not work in most of our urban contents at least.

(Refer Slide Time: 16:19)



So, a biogas plant is also like a settler itself it also somewhat does the same it has a little better efficiency, but of course, biogas plants are little more complicated to build. So, they are not as popular as the normal septic tanks because you have to make it really airtight and all that and there is often a reluctance and people to kind of use the biogas generated from night soil or you have to kind of have a combination of using your food doings also to feed it with; it can work, but it needs a little more acceptance from people if you and needs much more skilled labor to actually build a properly designed biogas plant, but effectively that also does the same the same with 30 percent efficiency.

(Refer Slide Time: 17:01)



So, what we have added as a next module in the DEWATS system is something that we called as an anaerobic baffled reactor. It sounds quite complicated, but essentially it is a tank which has at least four chambers. So, what happens is that as we all know your sludge that is there in an anaerobic condition which is completely sealed and all that the sludge inside naturally develops anaerobic bacteria in about 90 days time you have started developing the anaerobic bacteria into it.

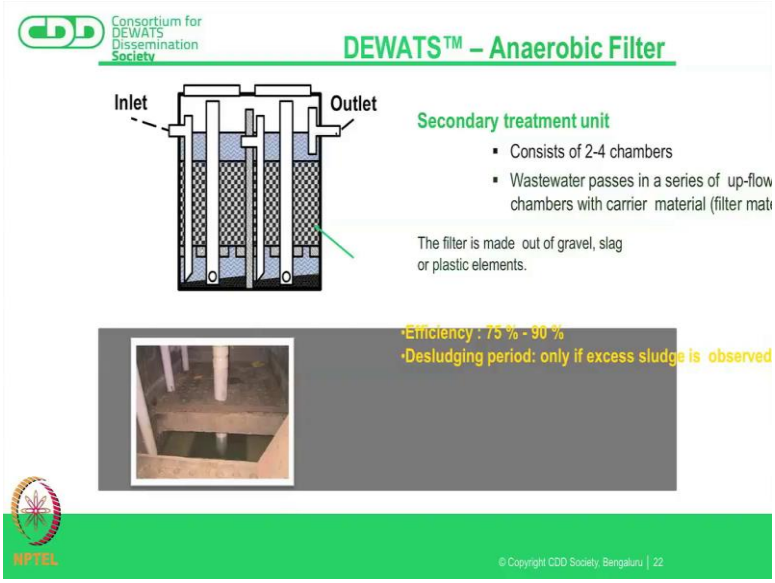
So, what we do in the anaerobic baffled reactor is that you are forcing your fresh waste water to flow downward get maximum contact with the activated sludge in the bottom when it goes to the then it up comes up again and when it flows to the next chamber. So, in this process so, we are actually I will show you towards the end that DEWATS has proper design spreadsheets that have been developed to actually workout the dimensioning and the size the depth everything of each of these systems actually.

So, properly designed baffled reactor we design the up flow velocity and we design the area of contact ground properly then with by the time it flows through each of these 4 to 6 chambers we can actually achieve an efficiency of almost 75 to 85 percent just by anaerobic processes alone. So, this gives a massive advantage in terms of the treatment efficiency actually. So, basically it is an up flow number of chambers where you give a active contact with the activated sludge in the bottom.

So, in as you revise as it comes to the last chambers your sludge also comes starts coming down because lot of the sludge is already eaten up by the fresh waste water that is coming in . So, that is the anaerobic baffled reactor and we again design the baffled reactor to have a desludging period of about 2 to 3 years or something like that depending on the space available and all the conditions and all that.

But, more than that what happens is that the sludge starts getting thicker and when the sludge start gets very thick it is very difficult to kind of desludge it. So, we would normally restrict it about 3 years or something like that.

(Refer Slide Time: 19:15)

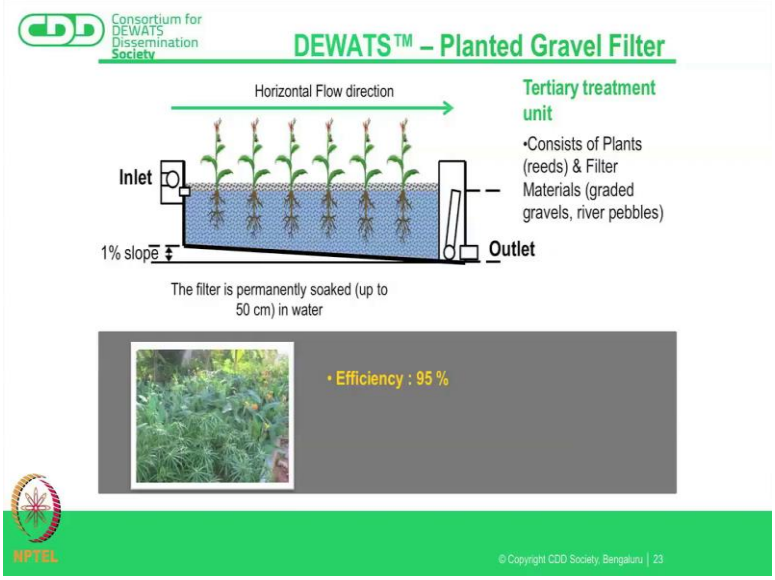


And, then the last I mean in the often in the last chambers of the baffled reactor we also add graded filter media which we call it as an anaerobic filter. So, what exactly is happening here is that the almost 75 percent treated waste water we try to give them a little more surface area for the bacteria to actually work. So, these are like again up flow chambers, but you have like a perforated slab here and you again do with an up flow so that and this is a filter media.

We normally use cylinder or something like that have has a lot of pores in it. So, that is you are creating maximum surface area for the aerobic bacteria to work. So, the last chamber of last one or two chambers of the tank is normally treated as an anaerobic filter which will give you an efficiency of up to 90 percent actually. So, this whole system these are all completely anaerobic processes. So, you just need properly designed civil

constructed tanks. There are no mechanical moving parts or anything like that, just that it has to be designed properly and all that.

(Refer Slide Time: 20:21)



And, after that so, what comes so, you know that we are looking at normal domestic waste water your BOD is generally assumed of somewhere in the range of 300 to 350 milligram per liter is the normal BOD that we as you understand all these basics know BOD and COD and all that I hope that you are all familiar.

So, if you are talking about an inlet BOD of about 300 to 350 milligram per liter; by the time you finish your settler your baffled reactor and anaerobic filter you can get an outlet BOD of to the tune of about 50 to 70 milligram per liter range you can achieve it. By normal discharge, Indian discharge standards with this alone you can let off the treated water safely into the ground, that is permitted by pollution control board norm.

So, with just completely anaerobic system you can achieve to the level that you can actually let it percolate if you have the soil condition that your water where your soil can actually let it absorb that water safely. Otherwise if you want to kind of take it to the next level of treatment that you would like to reuse it for let us say gardening or any other non-portable uses we added a module which we called as a planted gravel filter or they are also generally called as constructed wet lands also.

So, what happens in this module is that you know the general marsh areas know you find these semi aquatic plants which you find in many of these marshy areas. What they actually do is that they are absorbing the nutrients from the water and it treating it in a way. So, what we are trying to do in a planted gravel filter is to kind of create that kind of an environment that you actually make use of the most of these semi-aquatic plants they let out oxygen through their root system.

So, we go for shallow root systems which let out oxygen through it and you give that final aerobic treatment to those water that has come out of the anaerobic filter. So, the planted gravel filter is basically like an open shallow tank which has about 50 to 60 centimeters of graded filter media that is filled into it and they grow a lot of the semi aquatic plants like canna or typha or reeds and all that depending on what local plants are available which are shallow root and which are kind of semi-aquatic, any of those plants can be used.

(Refer Slide Time: 22:49)

And, once it flows through this and comes out you can easily get a BOD of less than 30 milligram per litre and more so, after the anaerobic process the water will still tend to have a slightly blackish color because it has gone through all the anaerobic process. But, finally, with the last treatment of a planted gravel filter you can get the water as really kind of clear and it is it does not have any odor or anything like that you can safely kind

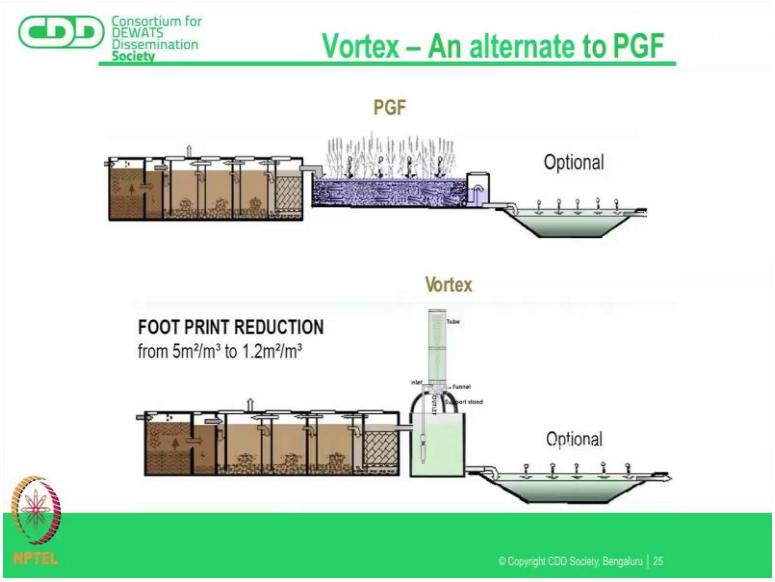
of reuse it. And, the planted gravel filter also has the occasional function that it helps in pathogen removal that is also another activity that happens in any planted gravel filter.

So, therefore, with the final treatment you can achieve an efficiency about 95 percent. So, with for all normal uses like even for using up to gardening or safely discharging into a water body this much of treatment modules are sufficient actually and you can see that this whole systems are completely passive. There is nothing that that needs a kind of very skilled operation or anything like that. Whatever maintenance that comes into it I will just show it to you.

Before I get into the maintenance part of it there is another module the only thing is that a planted gravel filter as you know all the other tanks you can do it below your ground and you can make use of the space above that for some activity. Very often where you get stuck we are trying to do waste water treatment system is that where is the space for it because everyone will be thinking about this only after they finish the whole building and some pollution control board is kind of knocking on their doors is when they think about the waste water treatment system.

So, all these anaerobic processes can be in sub-surface tanks or you can at least use a space above for something else. But, the planted gravel filter does need to be in the open can you can treat it as part of your garden as some of the case studies I show you in my next presentation you can see, but invariably it needs open space.

(Refer Slide Time: 24:43)



But, sometimes you have a situation when you are not even having that much of space available due to various reasons there is another model which has been developed which is called a vortex. The vortex as the name says it actually works on the same principle of the vortex.

So, you are actually forcing the waste water to create that the vortex effect, so that there is maximum aeration that is maximum air contact that is happening for the water and with the vortex you can actually bring down again the treatment as much or even more than the planted gravel filter. Only thing is that the vortex need power. So, and it needs certain amount of maintenance. So, if you are actually working on a situation for little bit of power usage is and you have some kind of personnel to kind of run and operate these system, a vortex can be or substitute for your planted gravel filter.

So, this is what the an overall DEWATS system will look like. You have the settler you have the baffled reactor; you have the anaerobic filter; you have the planted gravel filter and finally, you can either take it to a pond or something like that and use that water from there for your gardening and all that every part of your landscape feature and that kind of a last polishing pond also helps in the final package and removal also because your exposing the water to sunlight.

Or, you can have to see anaerobic process or settler baffled reactor filter and you can have a vortex and then reuse it. So, this is the basic processes that is involved in the in the DEWATS system.

(Refer Slide Time: 26:13)

This is how a vortex looks like. These are some demonstration modules which were developed just to kind of see how that actually vortex works and the kind of treatment efficiency that you can see is happening.

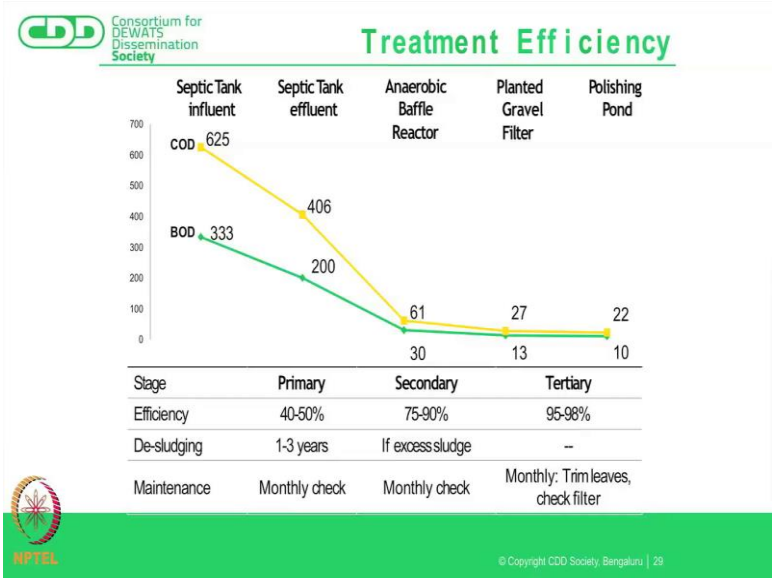
(Refer Slide Time: 26:29)

This is one project where actually have the whole of the anaerobic systems below the ground that we landscaped over and you just have this vortex and a small collection pond. So, the only thing that you actually get to see is this.

(Refer Slide Time: 26:47)

And, just to show that you can actually integrate all these things as part of your landscape, so that it can all look nice and be part of your overall features of it.

(Refer Slide Time: 26:57)



This is just a graph we just again summarizing the treatment efficiency as I said the septic tank this is the kind of if you are talking about an inlet BOD of about 330 or something, then out of the septic tank you might get this much of an efficiency. Your baffled reactor will give you this much of efficiency; the planted gravel filter you can get out BOD as I said of less than 20 and if you have a polishing pond or kind of a final

correction tank which can also give you a further aeration and all that. So, you can achieve it to less than almost like 10 milligram of BOD. So, this and so, you can see the steep curve is in the more of an anaerobic processes actually.

(Refer Slide Time: 27:57)

So, what are the kind of maintenance that one would need to kind of do for anaerobic treatment process. So, the first thing is if I because writes the other way round the basic day to day maintenance of course, is that whenever you have a any kind of a treatment system you have the first set of manholes from which you are taking your water into it. You will definitely have to see to it that bigger solids like sanitary napkins or diapers and things like that no treatment system can actually take care of it.

So, you do need to have that initial screens particularly in large use areas we are talking about hotels and hospitals or campuses and all that that kind of an initial screening and the and almost at least two or three times a week maintenance or the initial bar screenings or manholes collection chambers will be something that people will have to do. Then the other thing as in anaerobic the in the anaerobic process that is the only thing regular chambers I mean the initial manholes have to be taken care of.

And, then you will just have to do the desludging depending on your design period can be once in 1 year or 2 years or 3 years, you will have to kind of in a protocol for it and we will have to desludge those chambers. Desludging we all know right now the desludging pumps and conveyance are available. I think you are going to have another

session on faecal sludge treatment and management and all that. So, I am not going to do the details of it.

(Refer Slide Time: 29:21)

Then, in terms of your planted gravel filter and all that the regular maintenance would be one is that you have to ensure that the flow in and out of the planted gravel filter is maintained so, mainly because you have the plant roots which are growing. So, depending on your how much of treatment efficiently the planted gravel filter has you will have to trim your plants at least once in a month so that you have fresh plants growing and at least once in say 3 months or something you will have to remove at least one third of the plants, so that you are creating little more space for the for the new plants to grow up and improve it.

Otherwise after a while the bigger plants with their roots will spread too much and it can lead to clogging. And, we have from our experience actually only once in about 8 to 10 years you may sometimes have to completely remove and clean and backwash and put back the filter about that will be like a one once in 8 years or something like that that you may have to do it for anaerobic filter also but, other than that the daily maintenance of these things. So, these are all like the regular maintenance or things that the gardener or an unskilled person can actually take care of. Yeah, this I explained.

(Refer Slide Time: 30:27)

And, just last couple of slide. So, we the next step that we are trying to work on is on moving towards pre fabrication of DEWATS modules because as I said it for designing the DEWATS systems you too need certain amount of skills on understanding the one the design parameters, the complications and all that. So, now, CDDs are actually moving towards pre fabricating all these treatment modules, so that depending on your the how much of volume to be treated you can actually go for a modular system.

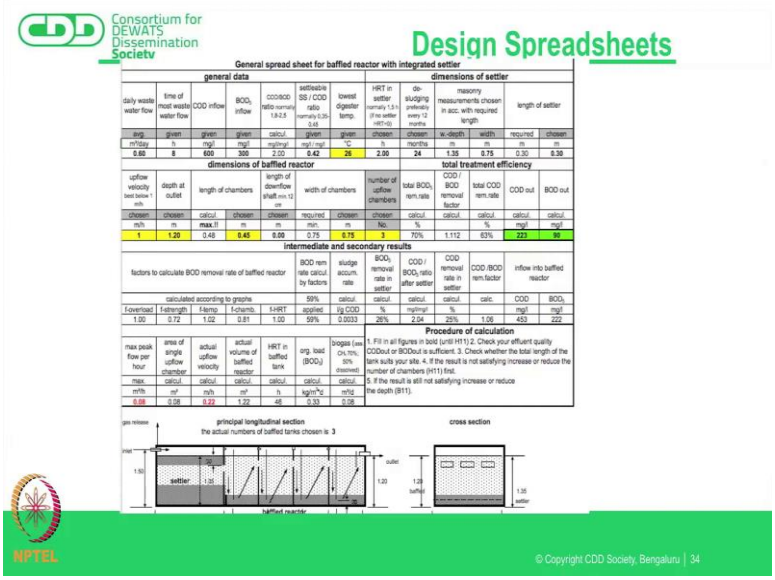
So, the will be like 1 m^3, 2 m^3 and 5 m^3 and 10 m^3 they can also depending on the treatment volume you can lay the system in series or in or in parallel and take it forward. And, that probably means little more efficiency in quality also. And, as I said we were talking about this whole decentralized waste water management systems we centralized city level faecal sludge treatment plant is a must.

(Refer Slide Time: 31:37)

So, while we actually try and push on getting people getting civic administrations to move for decentralized waste management it is also very important that we simultaneously lobby with the civic administrations to set up city level faecal sludge treatment units because whatever settled then you will have to desludge these units once in a year or two and all that. So, if you are taking a whole town and you can actually develop a protocol that each of these in settler streets will be desludged every week or something like that, so that and all those things can go to a centralized faecal sludge management.

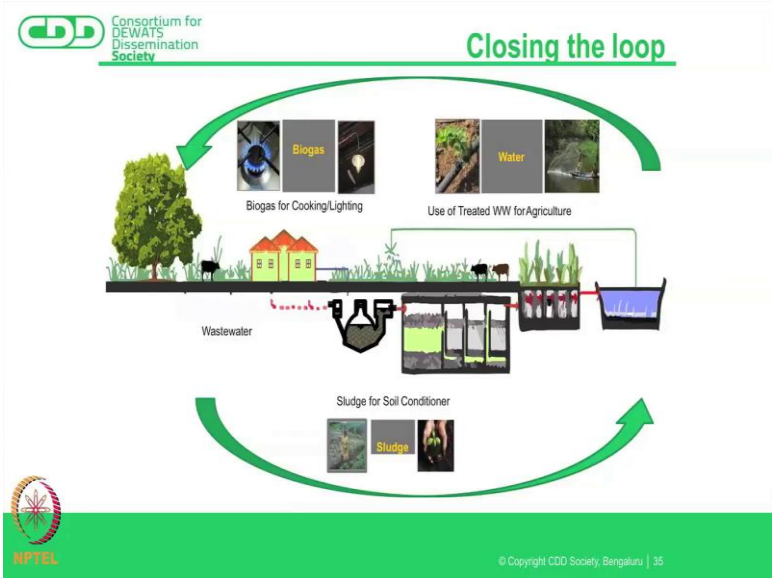
As faecal sludge management again can be treated with the DEWATS system itself similarly similar to the process that I explained earlier. Only thing is that the sludge volume will be more. So, we normally dewater the sludge and let the sludge dry and we use the water is treated and reused for gardening or whatever. So, this is the image of a faecal sludge management unit; the first faecal sludge treatment unit that CDD has set up in Devanahalli, near Bangalore.

(Refer Slide Time: 32:31)



So, these are the kind of designs spreadsheets I do not know how clear they are from there, but essentially kind of trying to tell you that the main things that we need to look at besides a quantity of flow the COD, BOD. There are also things like the your actual physical design parameters like how much depth can you go, how much width land that you have and all that the temperature factors the conductivity of the filter media and each of those things the organic load with that you are doing to make. So, based on all these things is how you actually design a DEWATS system.

(Refer Slide Time: 33:09)



So, this is the last slide of the presentation we are just kind of trying to say that the how we see DEWATS is that it actually is more effective and kind of closing the loop as you know. So, that because you are closing the loop as close to the planes of generation as it is as much as possible because; that means, that you are actually making it much more sustainable in terms of returning back the nutrients to the to the ground, returning back the water to where recharging the ground water and all that. So, that whole process is much more effective in a decentralised approach than when you compare to a centralized system.