Plastic Waste Management
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Lecture – 21
Impact of Plastic Pollution on Marine Life

So, hello and welcome to the week 5 of plastic waste management course. So, now, we are starting the second part of this course, we already finished first 4 weeks and I hope that you have been keeping up with the quizzes. And also I strongly encourage you to make use of the discussion forum for discussion and also not even not even just for asking question to us, but also discussion among all the different participants we have more than 9500 students who have registered for this course. So, there are quite a good number and many of them are very active. So, I encourage you to being be active as we make progress in this course.

So, in this week we will focus on what is the impact of plastic on health. So, when we talk about health what are the major plastic impact which gets lot of attention which is getting lot of attention is on marine life. So, when we like what is happening in plastic in ocean. So, we will talk about that we will also talk about effect on other wildlife on the animals, domestic animals, as well as some wildlife animals because plastic is making way to wild lives as well and then what are the chemicals of concern from plastics what is a human health aspect and some of the environmental issues associated with that.

So, that is what we will be trying to cover in this week 5 as you know every week we will have 5 videos of around 30 minutes each. So, let us get started with the first video for the week 5.

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And as I said the concept covered will be impact on plastic on marine life effect on wildlife and human health and the environment.

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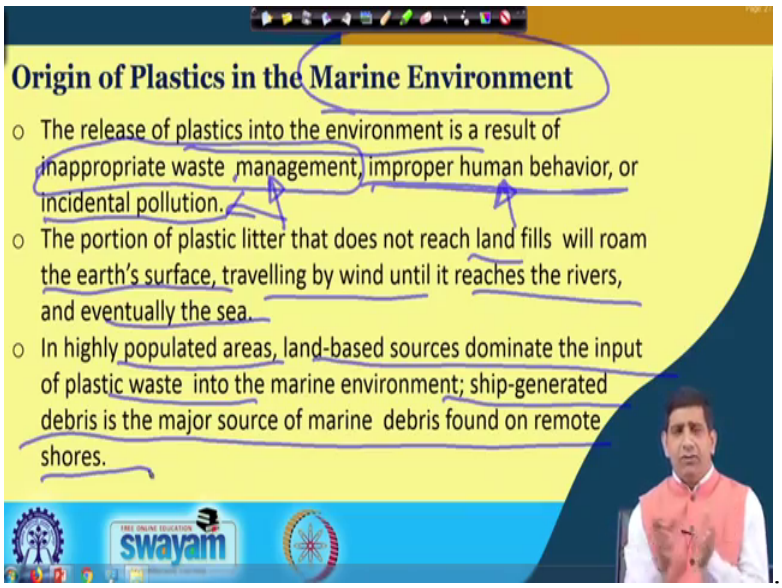

So, when we talk about plastic in marine that is one of the biggest news that made even the last world environment day national geographic came up with a magazine which was plastic or planet and you may have seen that magazine if you have not just Google it you will be able to see at least part of that magazine which is available for free.

So, this plastic or planet magazine was talking about how the plastic is getting into the ocean and not only like they also try to project what will happen to plastic in ocean say few decades from now. And it is said in that one of the article in the magazine that by 2050, 2050 which is around 2 2 right now it is 2019. So, we are looking at 31 years from now. In 31 years from now we will have more plastic in ocean than fish, one of the reason is of course, we are doing overfishing we are the amount of fish that we are taking out of ocean is much higher then what it can naturally replenish based on the fish population.

So, that is one aspect, but at the same we are making we if we do not manage the plastic properly if the plastic is mismanaged we will end up more plastic in oceans and not only plastic floating in the ocean, but plastic in the bodies of inside the fish. So, when an you and I consume some fish we will be getting exposed to those plastics and an associated chemicals with plastics which we will get into our body too. So, that is a that was kind of an alarming situation which was put forward. So, that was also discussed during the world environment day in India and national geographic team was in India and they took they were part of that world environment day program in Vigyan Bhavan.

And finally, the Government of India announce that by 2022 we will ban all single use plastics and many states around the country many cities around the country are already putting ban in place which we discussed in the previous week. So, the whole concept of this ban and other stuff is because of the concern related to plastic environmental and human health impact.

So, release of plastic is happening in to the in result of inappropriate waste management. So, see again the bottom line is it is not that if we have a proper waste management system in place which is essentially what we talked about in a in a urban setting we say that it is an the waste from for municipal solid waste, it is the municipal solid waste that we are mostly worried about because this plastic also makes way for the municipal solid waste.

So, in the municipal solid waste say in the municipal solid waste plastic is a big part right now it is around 12 percent in Indian context. So, if it managed this plastic waste properly if you have a source segregation in place as per municipal solid waste management rules 2016 if we follow the plastic waste management rules that

government of India has and many governments across the world has. So, we can try to make our case in terms of having a proper waste management practice. So, right now in we have a our we have a in appropriate waste management so, that is the biggest problem we have the inappropriate waste management is what is causing a lot of; so this inappropriate waste management which includes plastic waste as well which is creating a lot of problem in terms of plastic getting into the ocean.

Improper human behavior that is another thing is there because we are not ready to segregate the waste we are still many times we know that plastic is bad for us, plastic is bad for ocean, plastic is bad for environment, but still we keep on using plastic not only plastic lot of other material which we know is we should not use we should gradually phases out, but since they are so convenient the convenience actually take over our behavior and then improper human behavior we do not segregate it properly we just do lot of littering or incidental pollution.

So, the release of plastic getting into the environment is because of impropriate waste management. So, if we have a proper waste management it will be it will help if we can work with human behavior that will help and then if we can take care of incidental pollution especially from industries and other sources. So, if we can work on these sectors then only we can prevent the plastic pollution in ocean surface water and other places.

So, portion of plastic litter it is many of the plastic litter does not go to landfill and will it will keep around on the earth's surface, it will travel by wind it will reach river and eventually from river it will go to the sea. So, that is why in the marine environment so, if say if you miss manage a plastic if you might be living several 100 kilometers away from sea. But if you are miss managing plastic, if a city is miss managing a plastic that plastic waste especially those thin plastic very thin ones which floats in the air which goes with the wind can end up in the surface water and finally, to ocean. So, it is not that somebody living few 100 kilometers inland is not contributing to sea pollution of plastic it they he or she might be contributing if the plastic is not managed properly.

In a highly populated let us say if too much population you have the land based sources that is input to plastic waste ship generates a lot of major source of marine debris as well. So, as you go into the ocean you find that ship especially fishing vessels container ships

so, they will have lots of packaging material and other stuff they get their food supplies with lots of packaging and most of the waste material they just dump into the ocean. So, that is why it we have lots of waste being finding out in the ocean because of because of the ships that going around many times even the sewage they just release it into the ocean. So, because they do not have proper sewage treatment plant there so, they just release the sewage on the ocean.

So, those so your urine fecal matter like a sewage you take a water you take a shower in the ship and that those water then packaging material ship type it is a fishing vessels, sometimes they lose their fishing nets that also goes into the ocean. So, all those things makes way to the marine and that is where in the marine environment and that is how the plastic ends up there and it starts creating problem for us.

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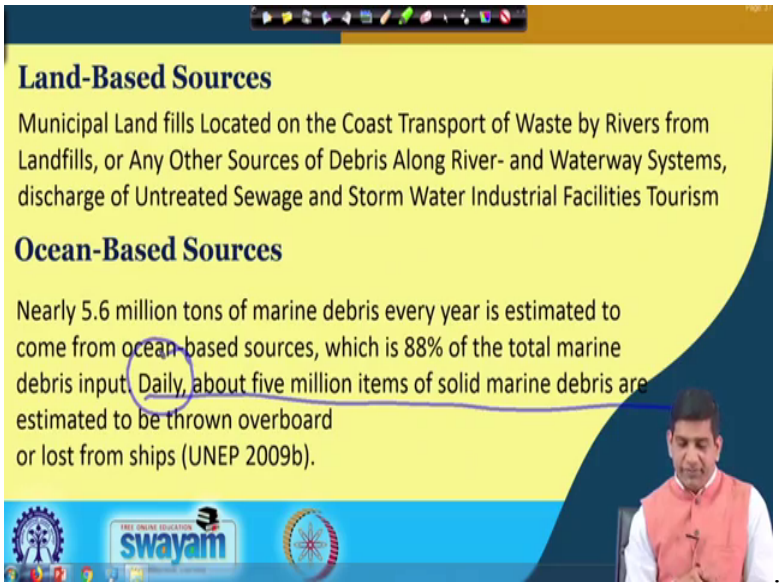

So, land based sources municipal landfills location on coast transport by waste by rivers from landfills if river has a touch to the littering and other stuff happening at the landfill, any other source of debris along river or waterway system, discharge of untreated sewage, a storm water industrial facility tourism and the those all those things kind of makes way there.

Then ocean based system sources we have nearly 5.6 billion tons of marine debris every year come from ocean based sources, which is 88 percent of the total marine debris input. So, this is the ocean based sources which is those big ships which goes around on

the ocean that contributes nearly 88 percent that is a huge chunk of waste actually coming from the ships just by ships.

Daily about 5 million items of solid marine debris are estimated to be thrown overboard or lost from ships. So, think about this number 5 million items of solid marine debris and that is daily. So, daily about 5 million items of solid marine debris are estimated to be thrown overboard or lost from ships. So, that is a lot of waste that we are dumping into the into the sea from our ships which goes around on the ocean so that is that is a big concern.

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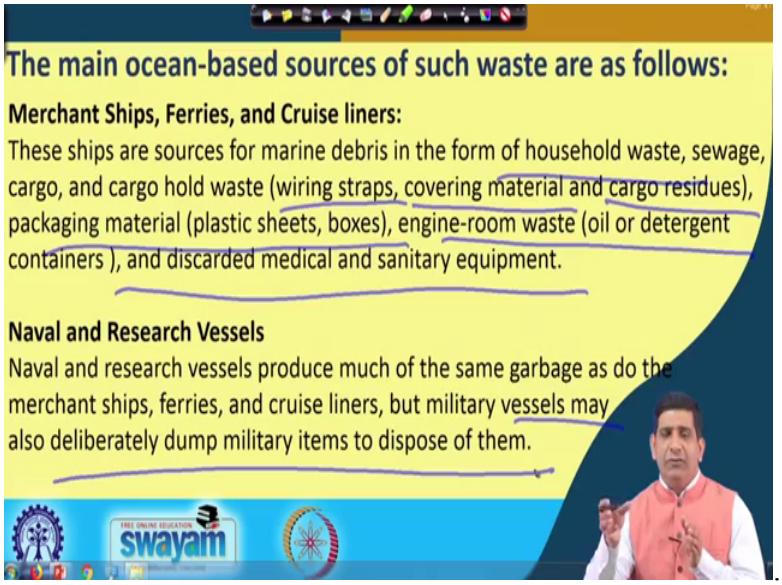

And main ocean base sources if you look at break up over there merchants, merchant ships, ferries, cruise liners, there they form of their many times we will have food and other stuff there as well. So, household waste, sewage, cargo, cargo hold waste wiring straps, covering material, cargo residues, packaging material, plastic sheets and boxes, engine room waste or discarded medical and sanitary equipments all these things are just going into the ocean. So, that is the naval and research vessel have the same garbage as do the merchant ships also deliberate they sometimes they also have some military items to dispose as well.

So, when we dump all these things in to the ocean of course, many of these things contains plastic and then plastic becomes a source of a pollution in ocean when there all other things in ocean tube. Plastic is getting a lot of a news plastic that is what recently I

was reading some of the articles which they say that it looks like we are thinking that we will be just solve, we will do some plastic ban and we will just solve, we will just work on some of these plastic pollution, And then whole worlds environmental problem will be solved that is that should not be that is not the way it should happened we plastic is only one part of the problem we have lots of environmental problem, we have lots of waste management problem, plus we should not get carried away usually that is what happens we get carried away with one issue and then we neglect all the other issues associated with in general issues which are maybe more important.

Right now we know that plastic is creating a problem in plastic has a negative impact. So, at sewage like many of our sewage treatment plan in the country is not working many of the would like a we do not have sewage treatment plan the capacity is also not there and not only in India many countries around the world mostly developing countries they do not have much they do not have hundred percent sewage capacity.

So, in to that is also a problem that is that is actually is maybe a bigger problem than the plastic pollution, but we get into one issue and then we try to neglect all the other issues and which should not happen we have to we have to have a balanced approach we are look at all the problems and try to solve and then one by one.

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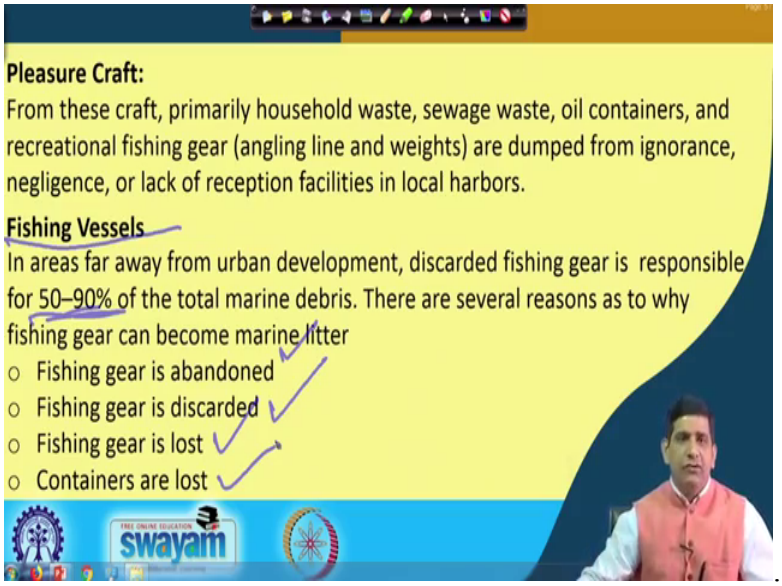

Pleasure craft this is again another from these craft primarily household waste these are your pleasure vessels which goes on ocean, we will have sewage, oil containers, fishing

gears are dumped either from ignorance negligence or lack of reception facility in local harbors so we just drop it there.

Fishing vessels in areas far away from urban development discarding fishing gear is responsible for 50 to 90 percent. So, look at this number 50 to 90 percent 50 to 90 percent of the total marine debris is coming from fishing vessels as you go away from land. So, it is a lot of waste going there, there is several reasons fishing gear is abundant, fishing gear is discarded, fishing gear is lost, containers are lost sometimes too.

So, one of the issues as if you remember we talked about that earlier that the reason we started looking this plastic pollution in the ocean is one of the Nike container one of the container having lots of Nike shoes they had by accident they got dropped like lot of shoes where lost in ocean. It there was some problem with that container it got loose and it opened and then many shoes get onto the ocean and the Nikes Company decided to recover all those shoes. So, that it becomes it does not become a plastic pollution, it does not become a not only plastic like it cannot become a pollution in ocean and when they started looking at removing this Nike shoes they found that there are lots of actually Nike shoes only a tiny thing.

Now, there are lots of other wastes in there especially or originating from different types of plastic now floating in the ocean and then what that is raised lot of awareness in terms of plastic showing up in our water bodies including in seas and oceans.

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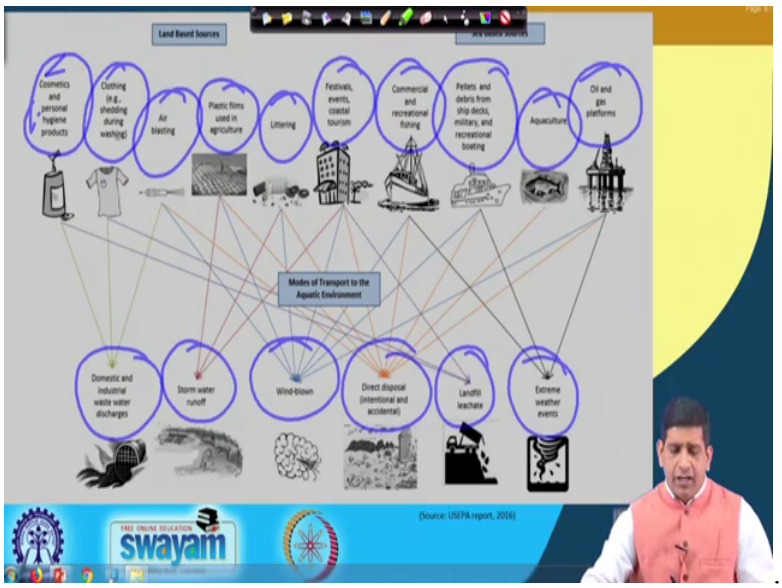

So, in terms of land based sources if you look at the land based sources how it gets into the water. So, if you start we use lot of cosmetics and personal care products, we use lot of there is a use of lot of cosmetics and personal care products. So, that contains plastics, micro plastics a lot of micro plastics are used.

Clothing would like some of the clothings have micro plastics now especially those shiny t shirts and the shiny stuff that you that you wear. So, plastic recyclable recycle plastic p t is go on into making those wrinkle free and take a what says it will not get wet. So, it is like a wet free or kind of the things that you use for the t shirts especially sports t shirts those contains lot of micro plastics and so when you wash them they get into the into the water as well.

So, there are some it goes into the air things goes into the air, plastic films are used in agriculture, littering of plastic waste festival events and coastal tourism. So, if you drop off lot of things in a coastal area commercial and recreational fishing, pellets and debris from ship decks, aquaculture, oil and gas platforms. So, all are the different sources from where the plastic gets into the ocean. So, that they go into the ocean either there are different modes of transport, let say from domestic and industrial wastewater discharge, from a strong water runoff, windblown, direct disposal, which is intense sometimes intentional, sometimes accidental, landfill leachate will have some microplastics extreme weather events.

So, we have some is like a tornado or hurricane and those kind of stuff which creates a lot of waste as well. So, there are different ways this land based plastic ends up in waterways and then finally, to ocean because ocean is the kind of shrink for all these for all the waste, so, it is kind of acts as a sink whatever is there in the surface water will eventually end up in the ocean.

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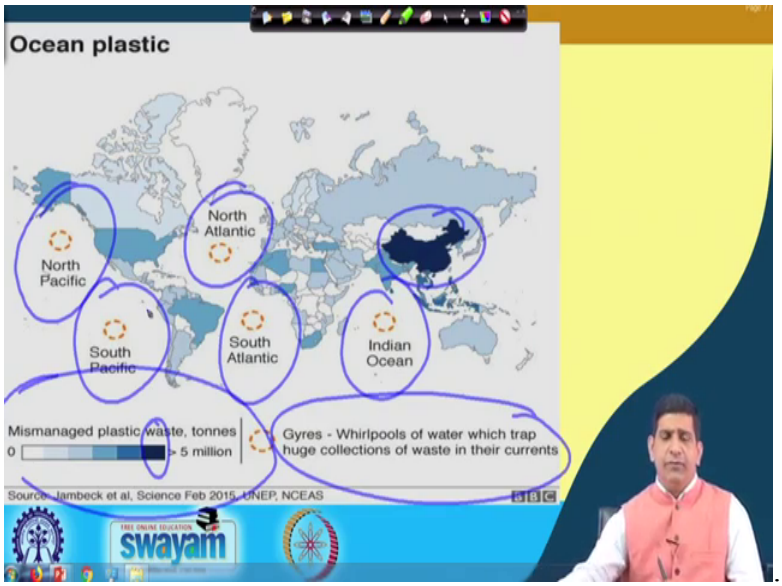

So, ocean plastic if you look at if you look at the global map and look at the different oceans and try to look at their plastics. So, here you can see the color has been given to us in terms of mismanaged plastic waste in turns and darker the blue set more is the numbers and anything with the dark blue darkest blue which is this color right there is greater than 5 million a tons of mismanage plastic waste.

So, as you can see the numbers are kind of very low in some of the like a European countries and also some countries in South America, US has slightly bluish shade Canada is better than if you the highest we see is in China then in India, Pakistan and those so you can see those shed over there. So, that is so what does it mean is we are there are a lot of mismanaged plastic and mismanage plastic is getting from different countries into the water bodies and finally, to the ocean.

So, in the ocean there are several whirlpools of water which traps huge collection of waste in the currents. So, they are also called there is a let us say gyres or there is lot of we have patches of plastic in the ocean. So, there is a great pacific garbage patch which is in the Pacific ocean we have not Pacific as well as South Pacific which we will talk about a bit more then we have Indian Ocean, we have South Atlantic, North Atlantic so, all these areas we are seeing some of the plastic which is just floating around and making a circle.

It is a just making a circle around it and this plastics are floating there and some of the some of the areas of if you look at the surface area of that floating plastics plastic area it is much more very high it is pretty high area which they are occupying and there are lots of plastic waste. And the plastics are getting broken down they are getting into smaller pieces and those smaller pieces are taken up by food by the aquatic species present there.

Especially fish and other species which are present there they consume it assuming that it is a food and that creates a lot of health problem for those aquatic animal and of course, it kind of goes up the food chain and may create health problem for humans as well.

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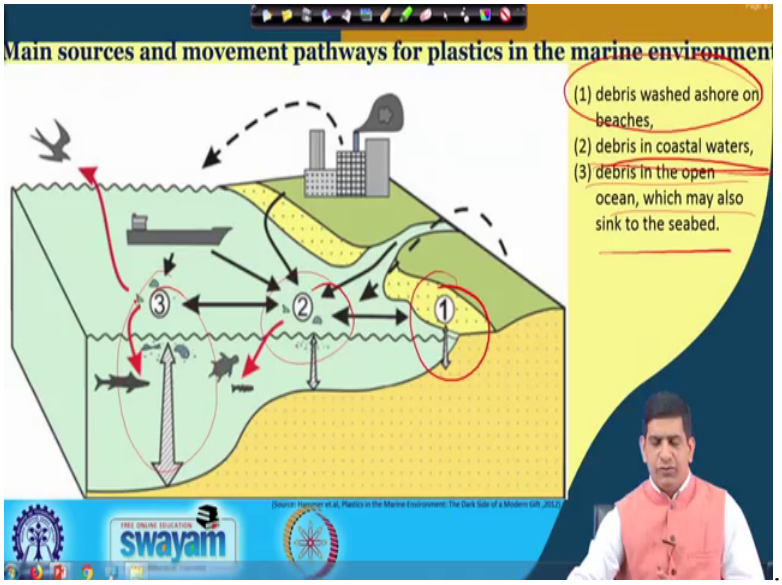

So, if you look at another way of looking at where you show the main sources and movement pathways of plastic and environment. So, it is a debris there are 3 major ways you can we can characterize it we have some debris washed ashore on beaches, there are some debris in coastal water, there are debris some open ocean which may also sink to the seabed.

So, there are three ways the three major categories so, we have debris which is washed ashore on beaches you leave lot of stuff on the beach and debris in the coastal water which kind of comes from different sources and the debris which kind of goes into the sediment and kind of a stage below and then which kind of interacts with the water once and also it is many times these smaller species they try to stay very close to the sediment and they consume all those plastic waste over there.

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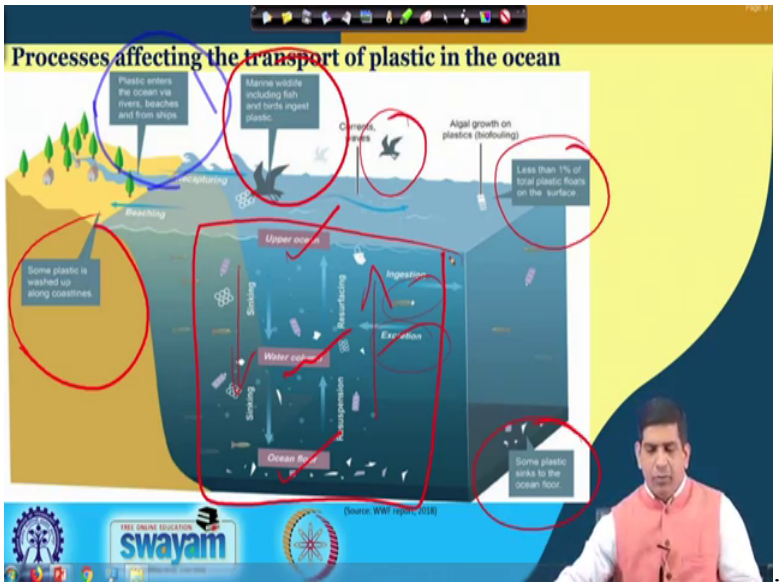

So, and then if you look at some of the fate and transport as stuff for the plastic in the ocean some plastic we have a plastic enters the ocean via rivers beaches or from seas. So, these are the way plastic is entering plastic is entering the ocean via rivers beaches or from ships. Then there are marine wildlife which is there which ingest plastic some plastic is also washed along the coastline because of people were going into the beach and leaving things over there.

Then you have the plastic kind of getting into this whole section here this is the upper ocean part, this is the water column and that is should ocean floor and as you can see there is sinking of plastic and then also there is a resuspension of plastic. There is ingestion by organisms there is also excretion by organisms which is happening which will which create some plastic.

Some plastic also sinks to the ocean floor they just go down less than 1 percent of the local plastic actually if they floats on the surface. So, most of the plastic is actually going down and settling down at the bottom, but and it is around 1 percent is on floating on the surface and that floating plastic on the surface becomes a food for these birds and marine wildlife. And they include fish they think that that is a part of the food because those plastic pieces are very shiny pieces and if you look at any aquarium or if you have been to any of these like a aquarium places you see that a smaller the fish more shiny they are

and since that is kind of and the plastic when it is broken down in a thin plastic that also is very shiny when the sun is on the top.

So, our birds or fish or the bigger fish they get confused and the thing that that plastic piece is actually a small fish to be eaten and then they consume it, but there is no protein and there is only it does not digest. So, it becomes part of their body and then it stays with the body and creates problem for the marine life.

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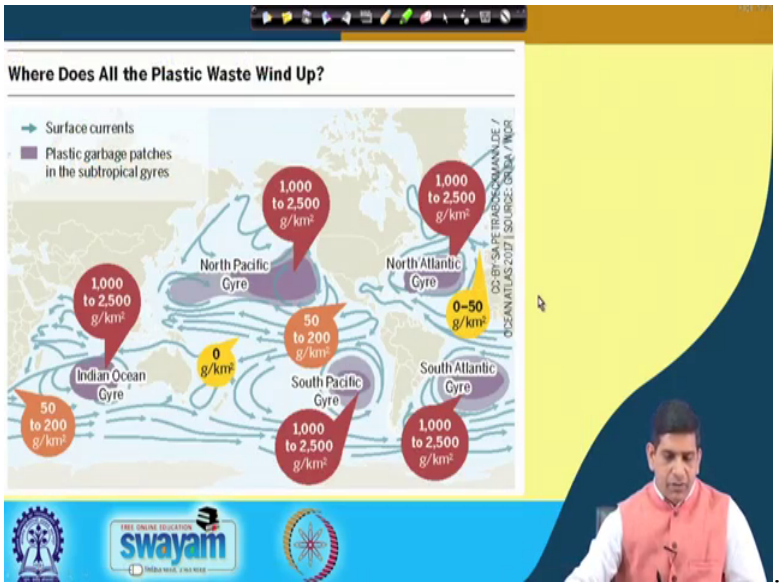

So, where does the all plastic wind up. So, right now if you look at in terms of global map we have several patches going on around in like Indian ocean, South Pacific, South Atlantic, North Atlantic, North Pacific and as you can see for most of those places the range is pretty much similar. So, it is around 1000 to 2500 gram per kilometer square.

So, that is where plastic garbage patches are there in subtropical gyres. So, that is where it is where you see those things are happening and then these arrows here showing you the surface current or the direction of the surface current so that is we how the currents are. So, as you can see most of these are most of this big garbage patches plastic garbage patches have 1000 to 2500 gram per kilo meter cube of a of plastic showing up there.

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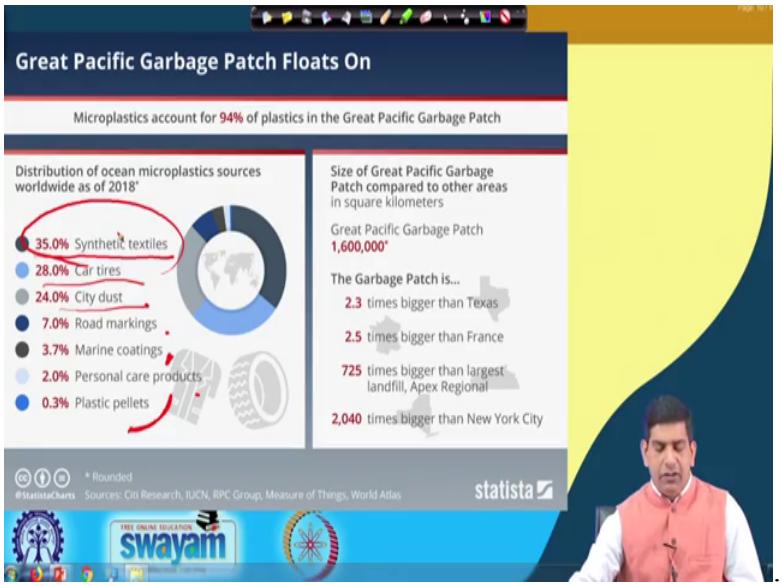

So, great pacific garbage patch which is in the Pacific ocean floats on the on the Pacific ocean it has microplastics, mostly microplastics around 94 percent in the great pacific garbage patch and if you look at their sources 35 percent of it comes from synthetic textile, then 28 percent is the car tire, 24 percent is a city dust, 7 percent from the road markings, 3.7 percent from the marine coating, 2 percent from the personal care product and 0.3 percent from the plastic pellets.

So, if you look at so in a in terms of the distribution of a plastics in from the great pacific garbage patch it is a synthetic textile which is more than one third, usually we think that it is APE bottle or the HDP bottle or the film plastic that we throw away it is they are harmful they are problematic, but look synthetic textile which we use a lot and that releases a lot of micro plastic and that is becomes a problem and that shows up in the ocean. Now if you look at the size of the garbage patch great pacific garbage patch is in 1.6 million is square kilometer which is around 2.3 times bigger than Texas.

So, if you Texas is a it is a one of the biggest state I think maybe the biggest state in the US in terms of area and so it is 2.3 times bigger than Texas 2 and half times bigger than France 725 bigger than largest landfill that we have in the world which is an apex regional landfill, 2040 times bigger than New York city. So, it is a huge area it is a huge area over which this garbage patch is spread and out in that garbage patch if you look at

carefully you have synthetic textile sources coming from car tires, city dust, road markings, marine coatings, personal care products and plastic pallet us.

So, those are, but these are plastic pallet us and other are very low predominantly it is synthetic textile car tires and city dust. So, those 3 is kind of more than close to 90 percent. So, that is that is the source and that so basically even most of them are not even part of the directly part of like municipal solid waste, but still if we if you as you can see we do see this most of these plastic waste are trying to make way to the ocean.

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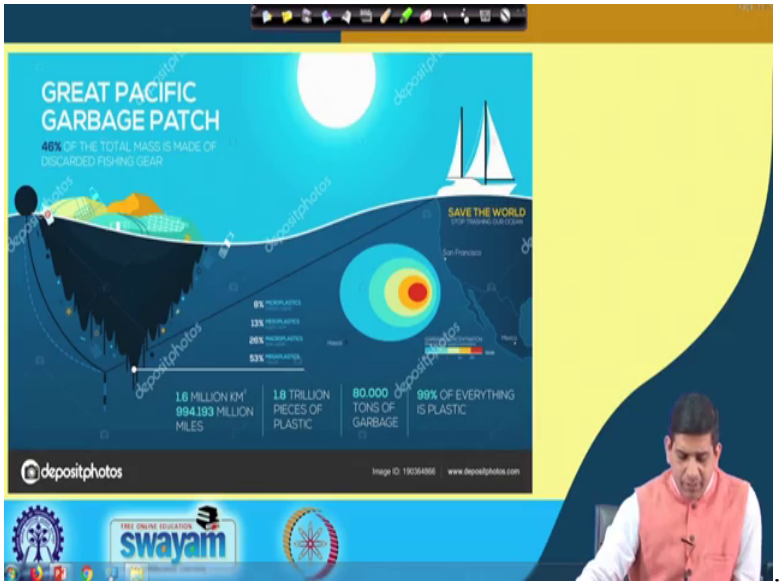

So, if you look at the great pacific garbage patch in slightly more detail 46 percent to the total mass is made of discarded fishing gear. So, lot of fishing gear people have just dumped it, 1.6 million kilometer we just we talked about, a 1.8 trillion pieces of plastic, 80000 tons of garbage, 99 percent of everything is plastic in their pacific patch.

Out of that 8 percent is micro plastic which we just talked about in terms of 13 percent is meso plastic which is like 0.5 centimeter to 5 centimeter, then 26 percent is macro plastic which is 5 centimeter to 50 centimeter and 53 percent is mega plastic which is greater than 50 centimeters. So, even like more than 50 percent is actually greater than 50 centimeter like half a meter. So, it is a big pieces which is which again keeps on getting broken down because of the current happening there. So, it does get broken down as the time progress.

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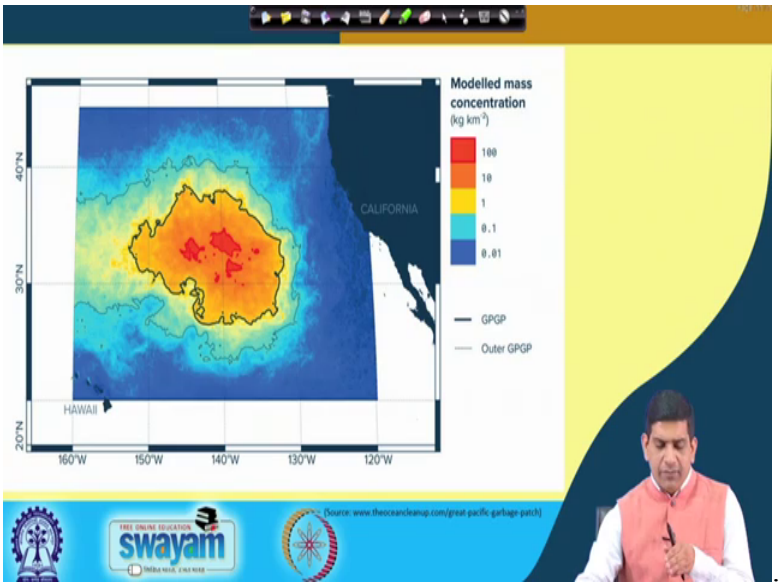

So, there was some study done in terms of modeling the term concentration of plastics in this great pacific garbage patch and then an experiment was also done. So, if you look at this model data which is kind of closer to Hawaii it is they had looked at.

So, if you look at the concentration which varies from kg per kilometer cube it is from 0.01 200 and 100 being the darkers darkest color. So, as you can see we do have 100 kg per meter cube kg per square kilometer in several pockets and we then we have 10, then we have 1 and we hardly see anything less than 1 in that great pacific garbage patch area. So, we still with lot of plastic is there.

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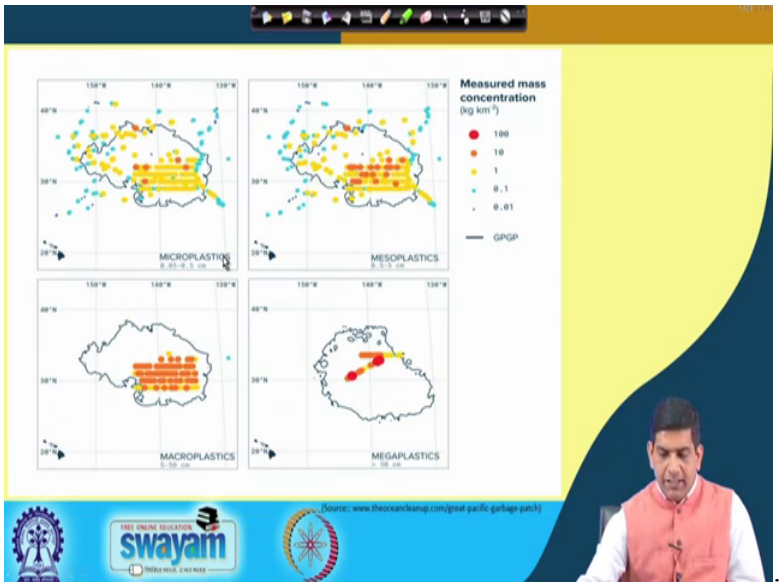

Then they had some major mass concentration and compared with the model and it seems that there was some for micro plastics mesoplastic as macro macroplastic as well as megaplastic and you can see that there are that variability which shows up in terms of different types of different concentration of plastic within that garbage patch area.

So, let us stop at this particular time where we have. So, we have just kind of finished looking at the great pacific garbage patch. So, great pacific garbage patch is one example of the big ocean pollution, there are other garbage patches out there which. So, again if you we are not going to cover each and every one, but those of you are interested you should go on YouTube go on Google and you should be find more detail about other garbage patches as well.

So, in general we are providing as mentioned earlier there is no textbook for this course. So, for every week we are providing some additional reading material. So, please look at that where there are more information is also provided, any question put it on discussion forum we will be happy to answer. So, again thank you. So, this was a first video of the week 5 we just finished we will go to the second video of week 5 after this and continue our discussion.

Thank you.