Chemical Process Safety
Professor Shishir Sinha
Department of Chemical Engineering
Indian Institute of Technology Roorkee
Lecture 12 - Material Safety Data Sheet – II

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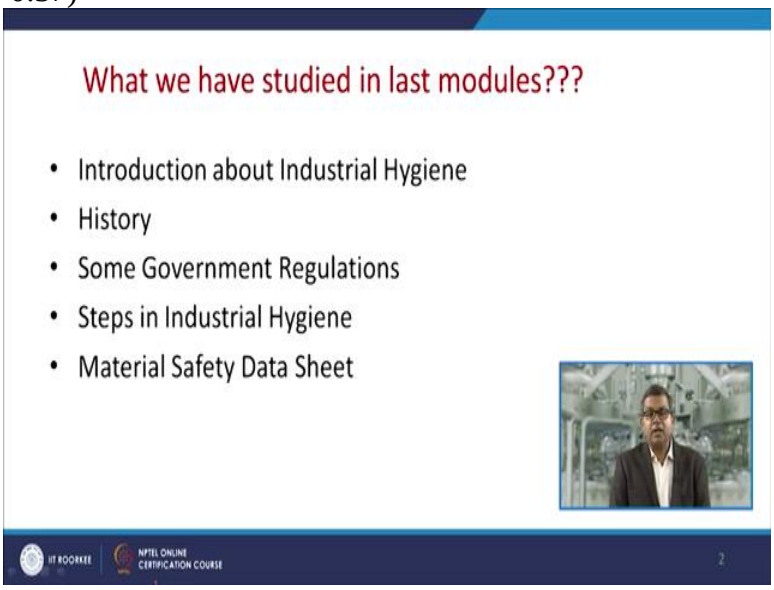

So, welcome to the next part of Material Safety Data Sheet. In the previous module, we have discussed about what is industrial hygiene and what are the different scopes, a brief history of industrial hygiene. Then some governmental regulations pertaining to the abbreviation, what are the steps involved in industrial hygiene like identification, evaluation and controls and as a part of the identification step we discuss the Material Safety Data Sheet.

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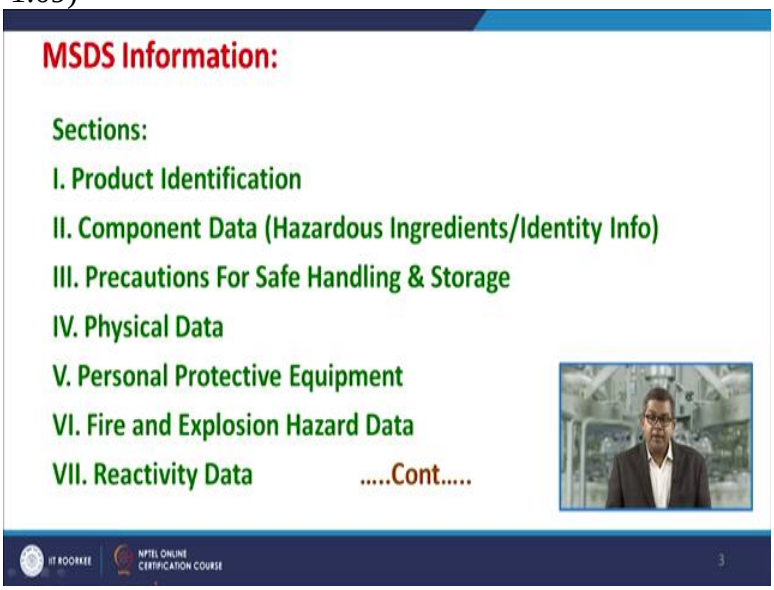

In the previous module, we have discussed partly the MSDS in terms of product identification, component data, precautions for various kind of safe handling and storage, physical data, boiling point etc, what kind of personal protective gears needed at workplace, fire and explosion hazard data.

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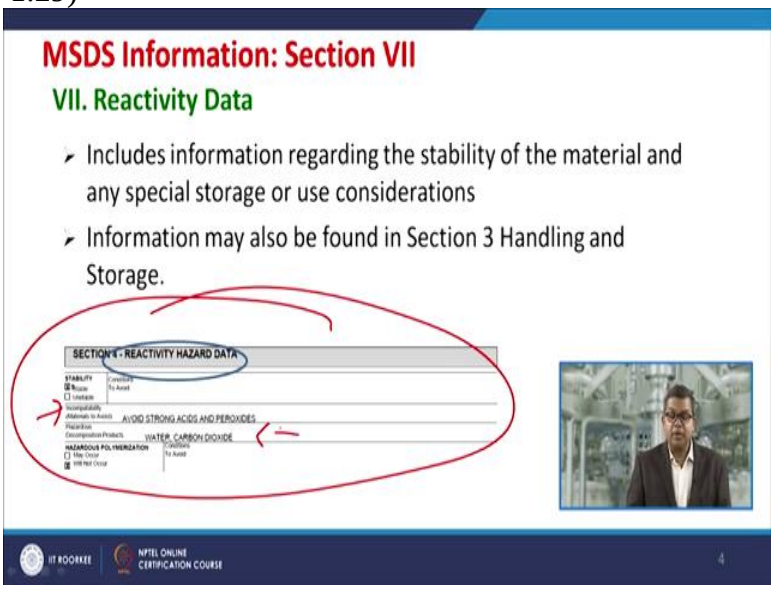

Now in this particular module, we will discuss the remaining part of material safety data sheet and what are the, the other integral part of material safety data sheet. So, the section seven usually deals with the reactivity data; so supplier, manufacturer, producer, they must provide this particular information that the particular component for which the MSDS is reactive to those

chemicals or those scenarios. So, this includes the information regarding the stability of the material and any especially storage or use considerations.

So all kind of precautionary or all kind of advisory related to the storage, related to the reactivity of the particular material with other components must be given. So, this particular information sometimes may be overlapped with the previous section which, which contains the information of handling and storage. So, you can see that this is the information that the particular component which is incompatible with strong acids and peroxide and hazardous decomposition products may lead to the water, carbon dioxide etc.

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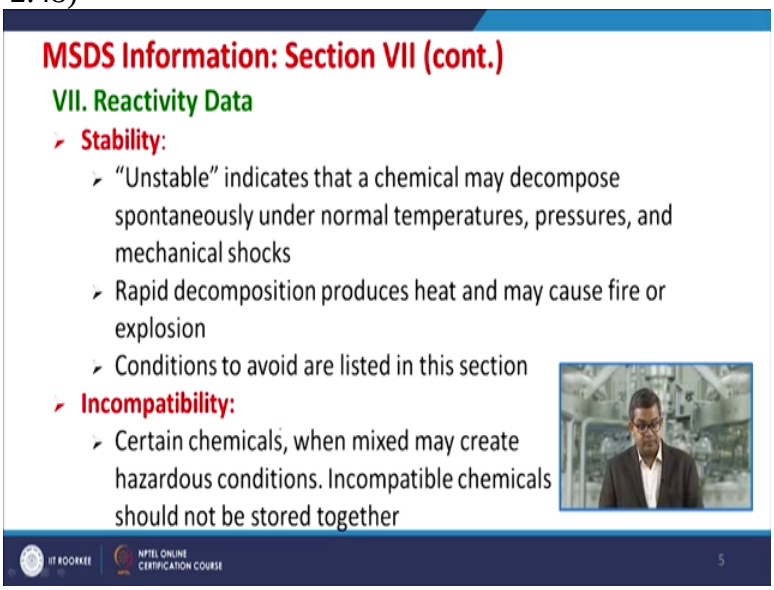

This particular section also deals with the stability aspect of particular component, unstable indicates that chemical may decompose spontaneously under the normal temperature, pressure and mechanical shocks etc. It may go on rapid decomposition, it may produce heat or may cause fire or explosions. So what kind of conditions must be avoided should be enlisted in this particular section. Also incompatibility with any kind of substance, they are certain chemicals when mixed may create hazardous conditions, incompatible chemicals should not be stored together so that they may create a problem.

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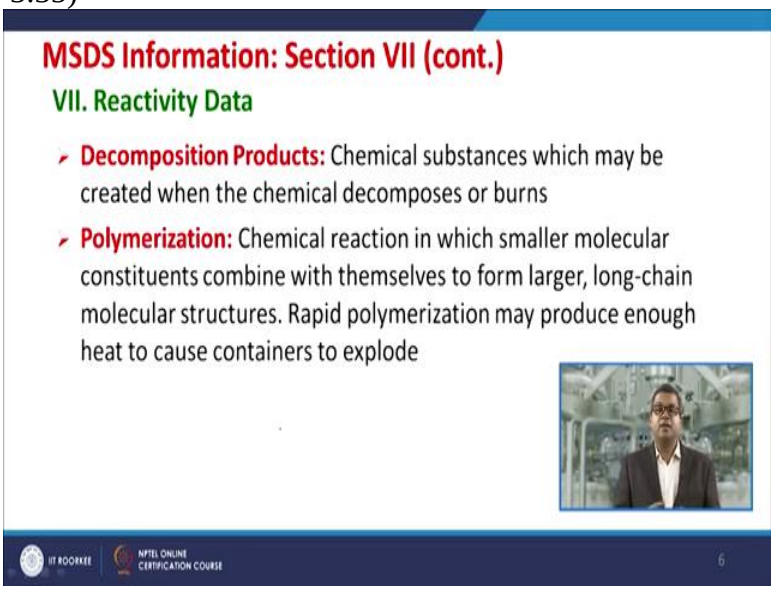

All kind of decomposition products information must be enlisted in this section. And what are those decomposition product like chemical substance which may be created when the chemical decomposes or burns. So this not only gives the storage information, but also provides the information, useful information for the use or during the use. Polymerization, this is again because certain like diagonal benzene etc, if they are not stored properly, if they are not handled properly, they may get polymerized and they create a lump of mass. So, the chemical reactions in which smaller molecule constituents or unsaturated molecule constituents combine with themselves to form a larger long-chain molecular structure.

So rapid polymerization may produce enough heat to cause container to explode. So, that is why what kind of advisory like sometimes they may need to be stored in a regulated temperature, environment etc. So this kind of advisory must be there. Now, the next section deals with the first aid because sometimes the user may encounter different type of problems. Like a spillover, like sometimes by any accidental procedure the worker or work man they may get exposed with that particular chemical. A cut, spray, cut etc may create a future problem. So what kind of first aid treatment should be provided to the workers nearby or the person those who are living nearby area?

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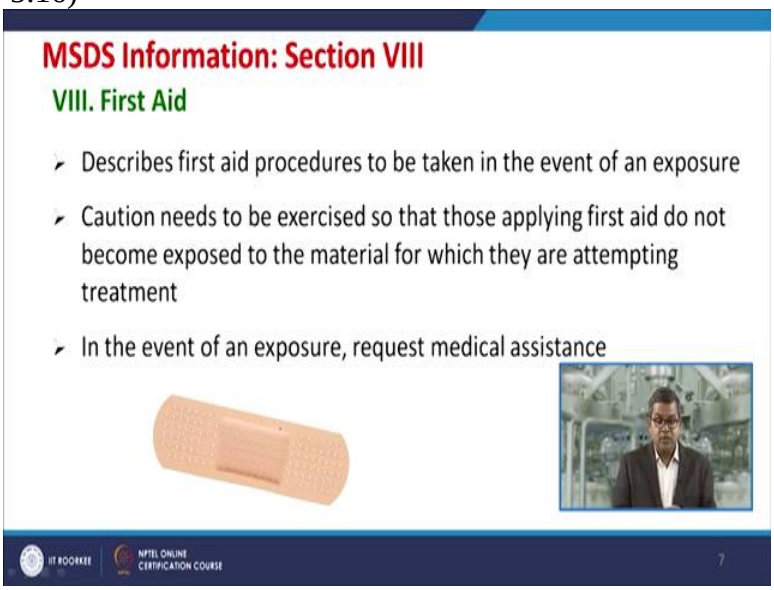

So, this particular section describes first aid procedures to be taken in the event of an exposure, what kind of caution needs to be exercised so that those applying first aid do not become exposed to the material for which they are attempting to treat. So, in the event of an exposure, request medical assistance, so this type of information must be enlisted in this particular section.

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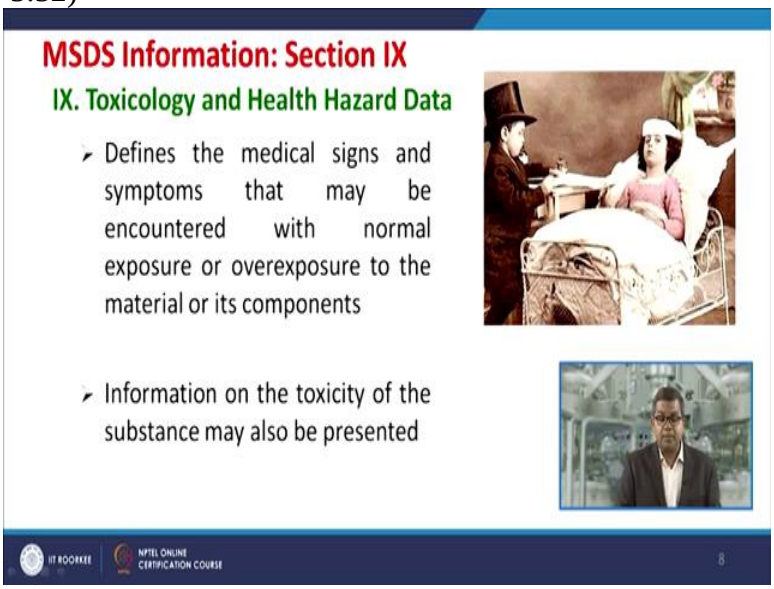

In the next section, all kinds of toxicological and health hazard data must be there. Now, this defines the medical signs and symptoms that may be encountered with the normal exposure or over exposure to the material or its components. The information of the toxicity of the substance may also be presented in that particular section.

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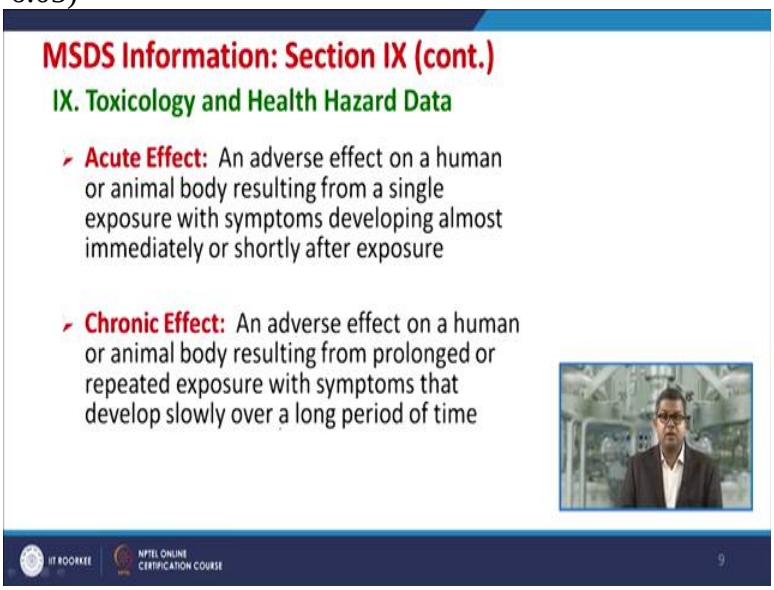

Now these toxicological data or (toxic) health hazard data must be represented in two facts, one is the acute effect, that is an adverse effect on human or animal body resulting from a single exposure with the symptoms developing almost immediately or shortly after exposure. The chronic effect, an adverse effect on a human or animal body resulting from prolonged or repeated exposure with symptoms that develop slowly over a long period of time. So both the things are extremely dangerous.

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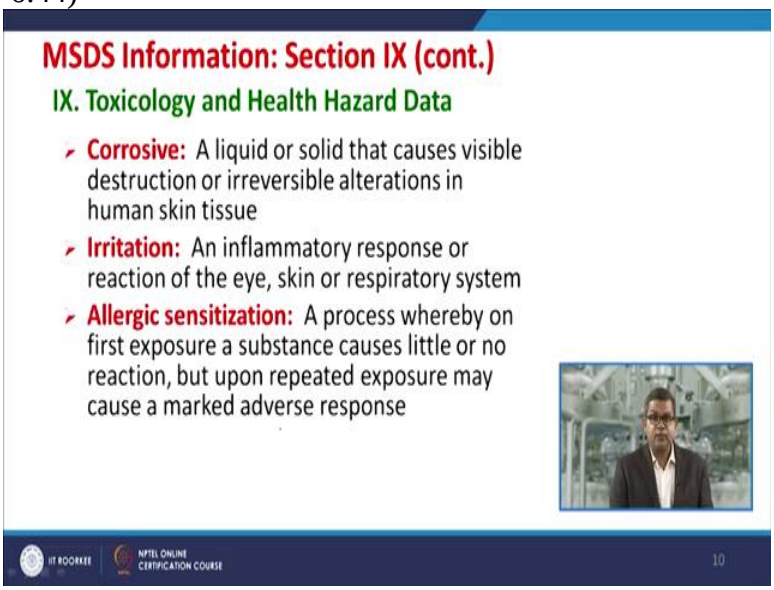

Apart from this, the things like corrosiveness, irritation, allergic sensitization, etc. Now corrosive, a liquid or solid that causes visible destruction or irreversible alteration in the human

skin tissue. Sometimes you may experience that, if you are working in chlorine environment, the skin may become dry, etc. The irritation, an inflammatory response or reaction of the eye, skin or respiratory system. Allergic sensitization, a process whereby on first exposure, a substance cause this little or no reaction, but upon repeated exposure may cause a marked adverse response. So this type of information should be enlisted.

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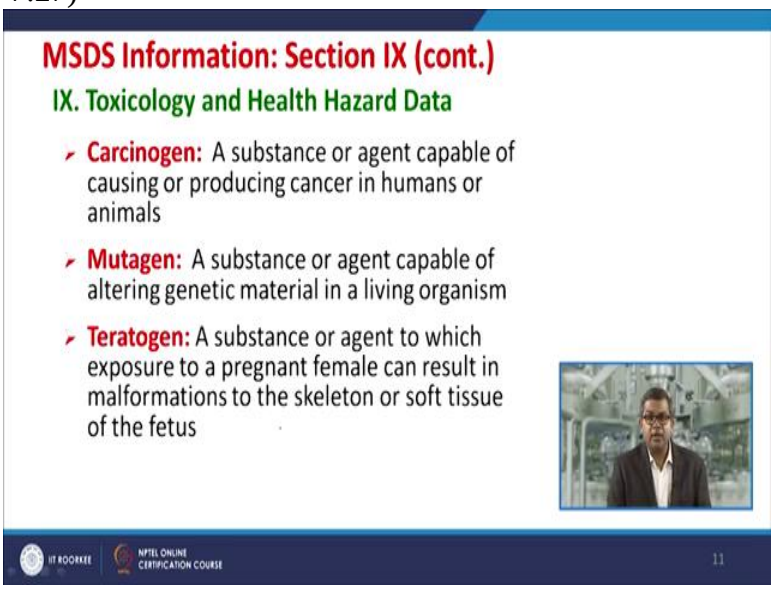

Carcinogenic, a substance or agent capable of causing or producing cancer in human or animals like methyl isocyanide. This type of information should also be enlisted. Mutagen, a substance or agent capable of allergic sorry, alerting genetic material in a living organism. Teratogen, a substance or agent to which exposure to a pregnant female can result in malformation to the skeleton or soft tissues of the fetus. So this information is again essential and sometimes if this particular information is not applicable to the chemical in question, then it may be listed in terms of non-applicable, not applicable etc.

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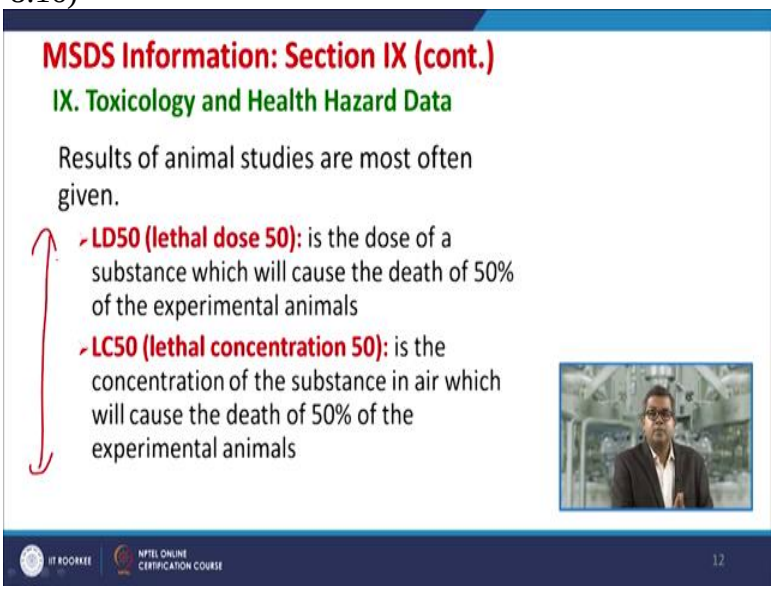

Results of animal studies, they are often given in terms of LD50, LC50. LD50, the lethal dose 50 is the dose of substance which will cause the death of 50 percent of the experimental animal and LC50 is the concentration of the substance in air which cause the death of 50 percent of the experimental animal. So, this is again gives the information that if the higher LD50 or LC50 number, that means you have to take care properly that particular component.

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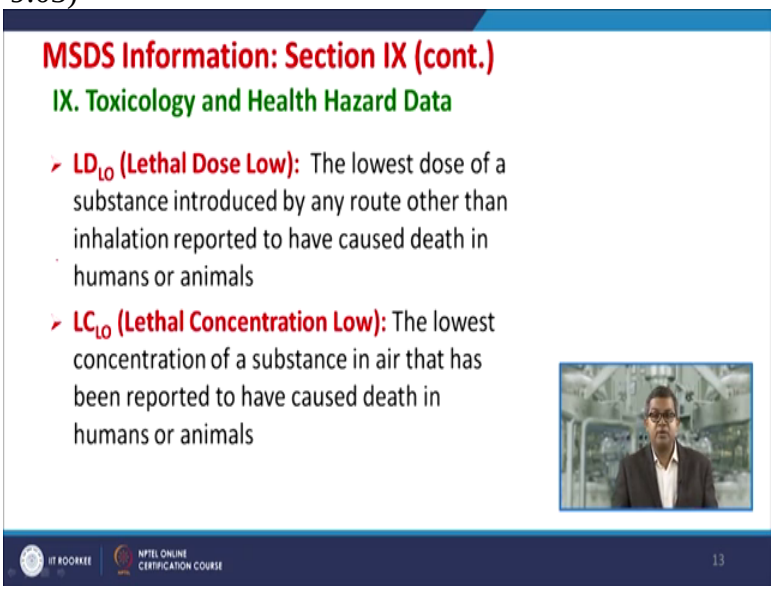

Sometimes it is represented in the form of LD low or LC low, the LD low is the lowest dose of a substance introduced by any route other than inhalation, reported to have caused death in human

or animal. And LC low is the lowest concentration of a substance in air that has been reported to have caused death in human or animals. So this type of information is also there in MSDS.

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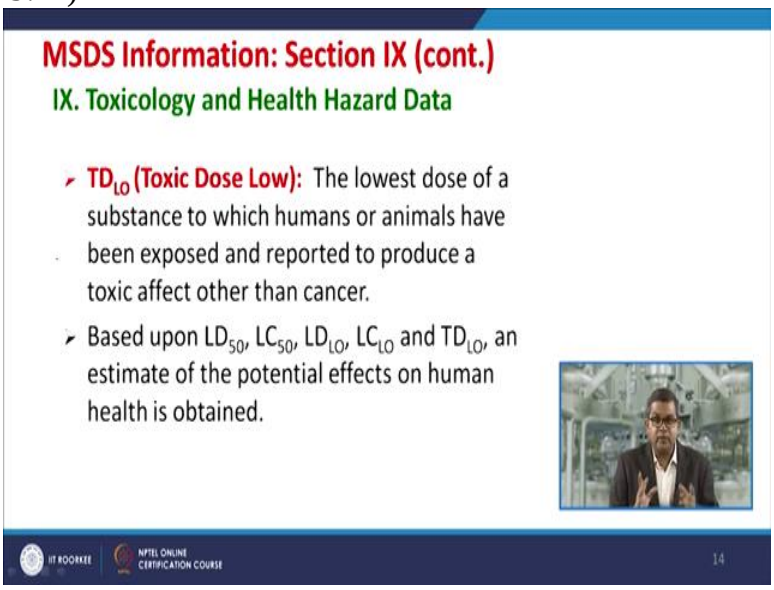

The toxic dose low, this is the lowest dose of a substance to which human or animals have been exposed and reported to produce a toxic effect other than cancer. So based on LD50, LC50, LD low, LC low and TD low, an estimate of the potential effect on human health is obtained so that you can adopt the control methodology accordingly, because unnecessary sometimes, if you are taking due care and unnecessary care of workplace then definitely you are pumping more money towards the safe expenditure and per unit cost of your product will be on the higher side and in the competitive era you will be out of the business.

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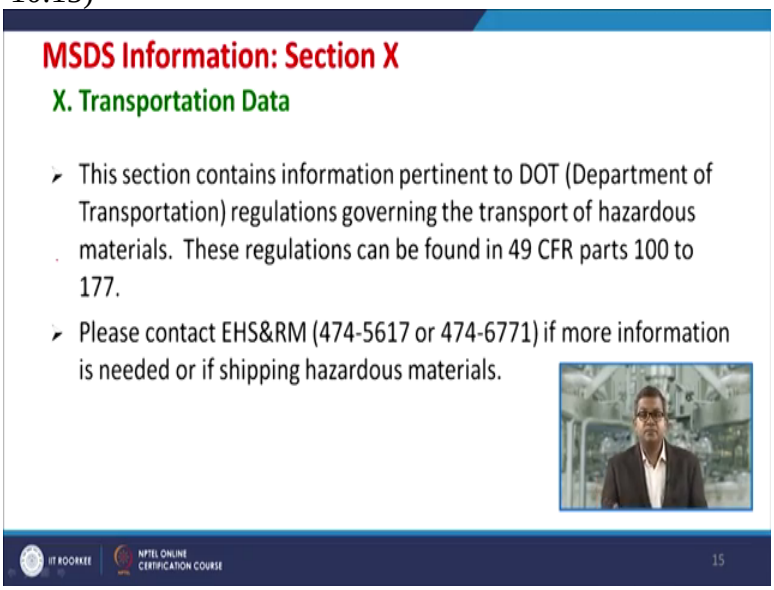

Now, the next section deals with the transportation data, usually this contains the information pertaining to Department of Transportation, regulations governing to the transport of hazardous materials. Now, these regulations can be found in 49 CFR parts 100 to 177. Now, why this, we must give importance to this one because sometimes you need to transport your prepared product to some other place, then what kind of precautions you need to take? It is just like that, suppose you are producing any petroleum product like petrol or a diesel and you are transporting from refinery to some storage depot or sometimes from a storage depot to the vendor etc. Then what kind of precautions you need to take because they are highly flammable and once they are highly flammable, then you need to follow a certain protocol, whether it is a pipeline pumping, whether it is a tankard or whether you are going to store it.

So you need to follow a proper protocol and that is why the different governmental agencies they provided the proper protocol for each and every component for applicable for the transportation of that material. Now, in case of any confusion, you may be advisable to contact EHS&RM or the manufacturer or supplier.

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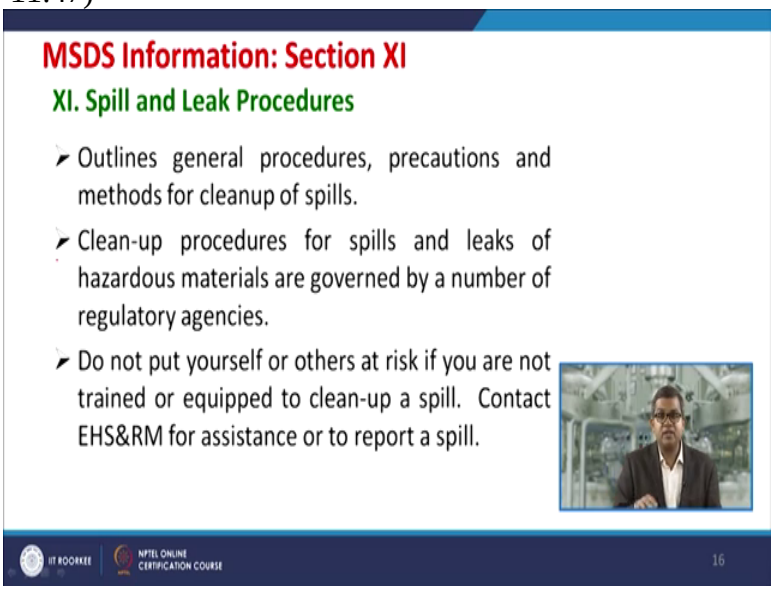

Sometimes during the use, the flammable or a toxic material may get leaked or spilled. So, in that particular case, what kind of procedure, what kind of protocol you need to adopt? So, this particular information usually enlisted in Section 9 of the MSDS. So this outlines the general procedure, precautions and methods for cleanup of any spill because whenever there is any spill, it not only creates a problem to the workplace, but sometimes it may go away through the housekeeping process to the drainage and it may create the future problem in environment.

So, this particular section deals with that particular information for the cleanup of any spills, cleanup procedures for a spill and leaks of hazardous materials usually governed by a number of regulatory agencies and you need to follow the protocol, do not put yourself or others at risk if you are not trained or equipped to clean up a spill. Sometimes mercury may get spillover or it may be leaked to some place, it is highly carcinogenic in nature, so you need to adopt a proper protocol and if you are not aware it then contact the consult, to consult the proper person who is trained, who is acclimatized for that particular scenario.

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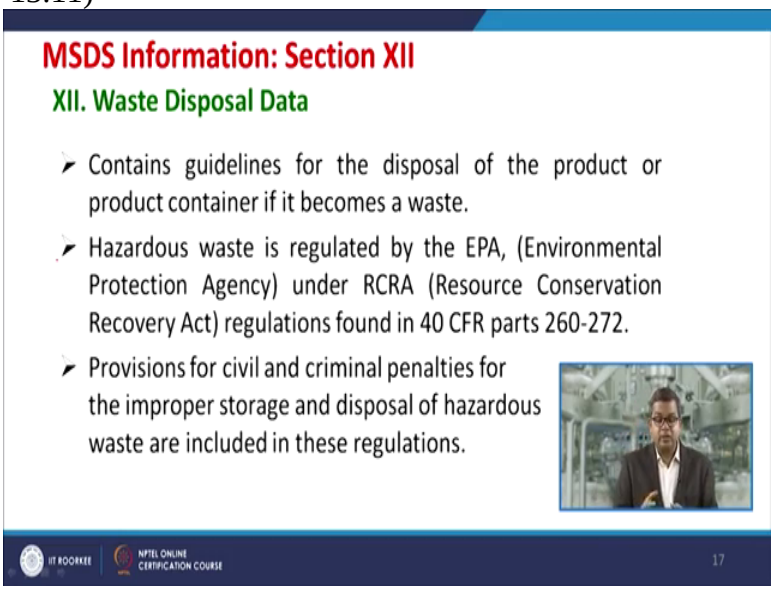

Apart from this other section deals they are, deals with the waste disposal data, this contains the guidelines for the disposal of the product or product container. If it becomes a waste sometimes, it is probably like in various tanning industries the chromium, the TDS etc, they become the part and parcel of waste water stream. So, this gives the guidelines for the disposal of the product which contains the waste material. The hazardous waste is regulated by different regulatory agencies like in Indian context, CPCB, NGT they provides the guidelines. Provisions for civil and criminal penalties for the improper storage and the disposal of hazardous waste are also included in these regulations.

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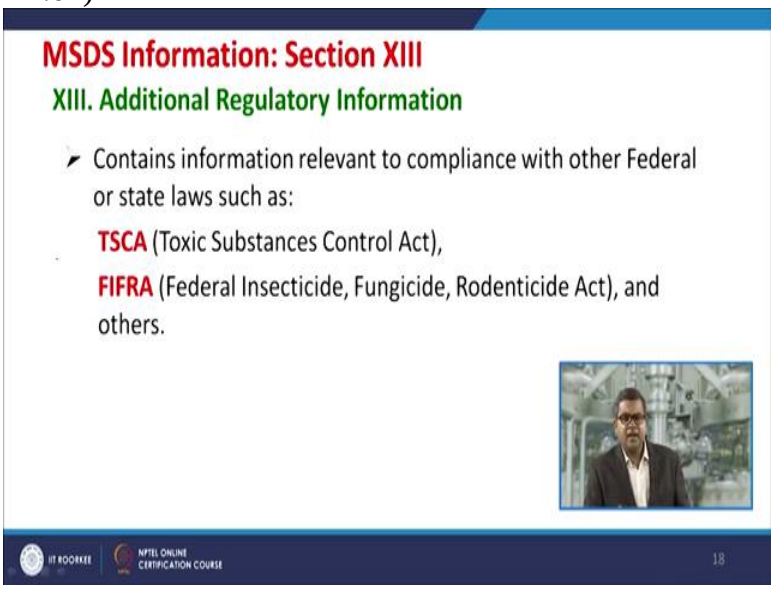

Sometimes you may enlist the additional regulatory information and it is also essential that suppose, if you are using that particular chemical for a particular space in a particular state which is being regulated or which is being the protected state then you may provide some additional information for the use of the person those who are using in that particular protected zone.

This contains the information related to the compliances with other state laws or the central laws like TSCA Toxic Substances Control Act, FIFRA Federal Insecticides, Fungicides, Rodenticide Act and others as per the requirement. Now sometimes some additional information not only not related to the regulatory, but some other information which manufacturer would like to be give to their user may be listed in the section.

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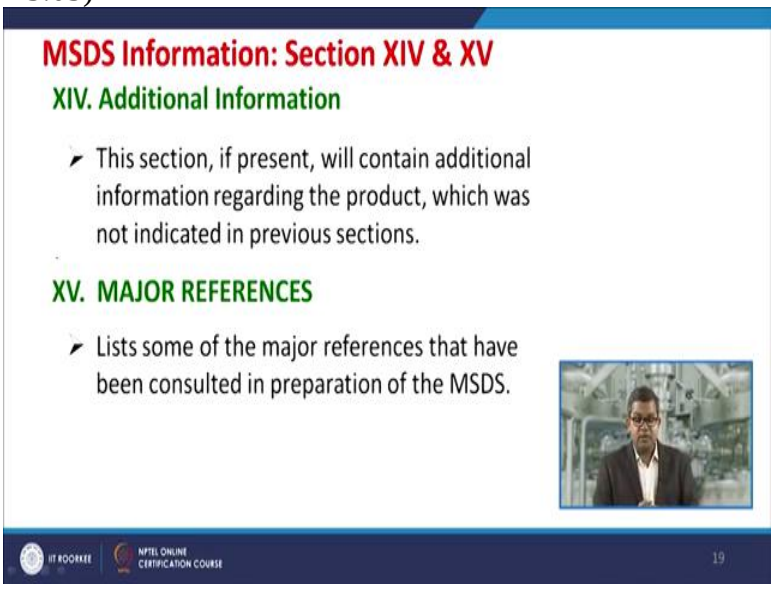

So, this section, if present, will contain additional information regarding the product, which was not indicated in the previous sections which are very exclusive. In the last section or last but one section, manufacturer may enlist some major references. So, list some of the major references that have been consulted in preparation for the MSDS. Because sometimes for the researcher or for the product innovators, they may require some more information of that particular product. So this particular section provides useful information for them.

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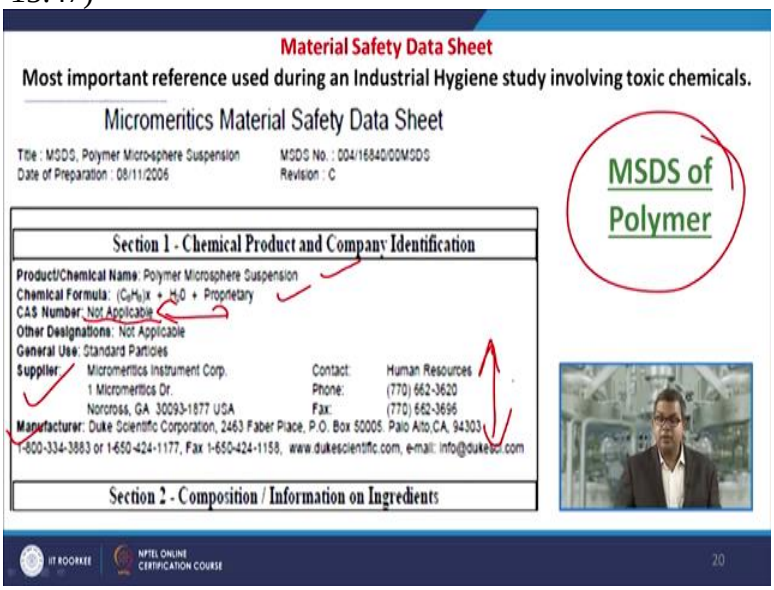

Now in this particular section, I am giving you the sample MSDS, the two sample MSDS are listed in this particular section. One is related to the MSDS of a polymer, you can see in the section one that is a chemical product and company identification, the name, the chemical name of the polymer is given, then the chemical formula, this time the CAS number is not applicable. The other see, one important point is that if anything is not related to that particular component, you should not leave it as blank, it should be listed that it is not applicable. The other designations, general uses etc, then the supplier name and the manufacturer and what all kinds of information, the contact information is enlisted.

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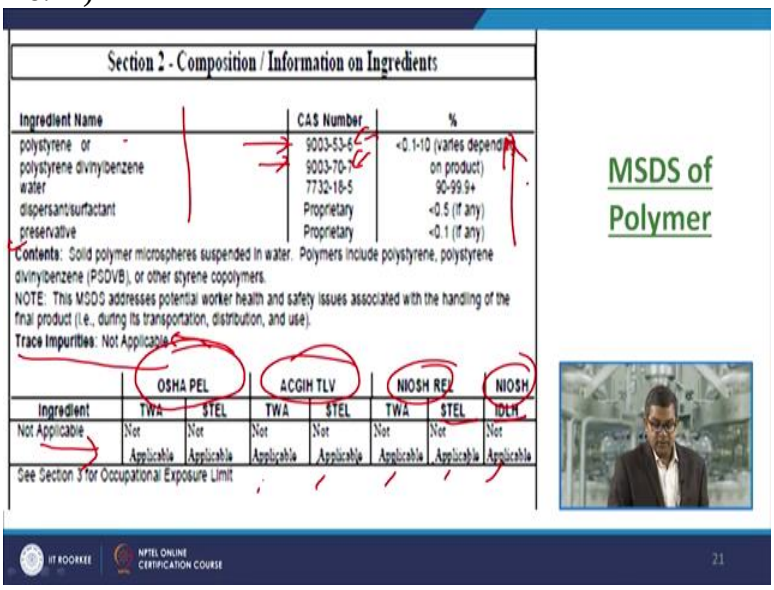

The section two deals with the composition, information and ingredients. Now remember, this is not the pure substance, so what are the ingredients enlisted in that particular component? They are enlisted over here like polystyrene or polystyrene divinylbenzene. So, for each and every component the CAS number is enlisted. So, in case if you wish to have other information for this particular polystyrene or polystyrene divinylbenzene, then you can have it from these CAS numbers. Then on what percentage they are present, water, the other preservatives etc. Some additional informations like contents, the solid polymer, microsphere suspended in polymers etc.

Whatever manufacturer would like to provide, it can be enlisted over here. The trace impurities again you cannot leave it blank, it is not applicable; then in this particular section that what are the different limits? Like permissible exposure limit ACGIH TLV, NIOSH, REL etc. These are immediate death data, short-term exposure limit. So, if it is not then it is not applicable. Everywhere you can find that it is not applicable.

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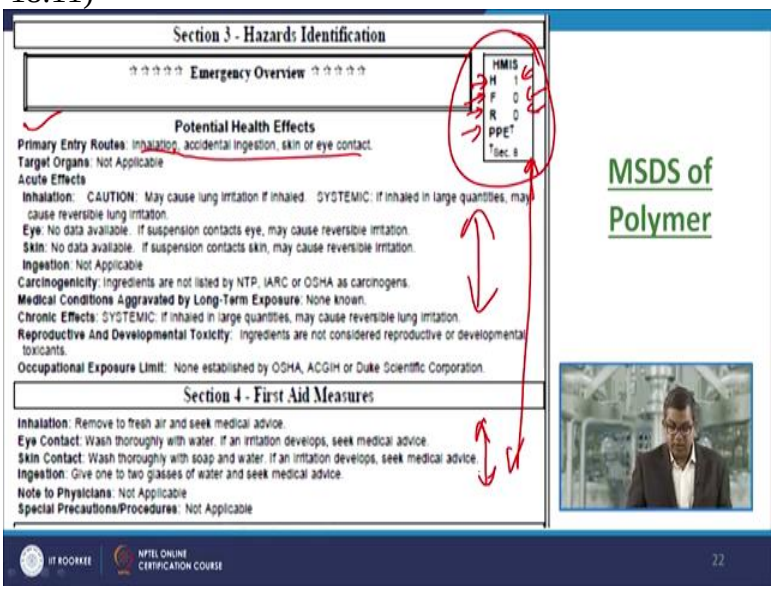

Then hazard identification, you can see which we have discussed in earlier section that hazard data, fire data, reactivity data and any kind of personal protective equipment data. So, all these things are enlisted, the potential health hazard number that means, it is having the no chance of fire, it is highly non-reactive. Health hazards on the, as you can say the moderate level, then it is enlisted that potential health effects, primary entry of route because it is the mandatory that out

of four routes, which route is more prone towards the entry of that particular chemical to your body system.

So, all four routes, it can enter (into) through all four routes. Target organs they are not applicable, that means you can discharge it as quickly as possible. What are the acute effects, caution, eye, skin carcinogency, then medical conditions etc? So, these are the important information enlisted over here. Now, because based on this particular aspect, if anybody get contaminated with this chemical, then first aid measures, what kind of first aid measures you need to adopt? Inhalation remove to fresh air, then in case of eye contact because all four routes are applicable here, then in case of skin contact, ingestion, so all kind of precautionary measures are enlisted over here.

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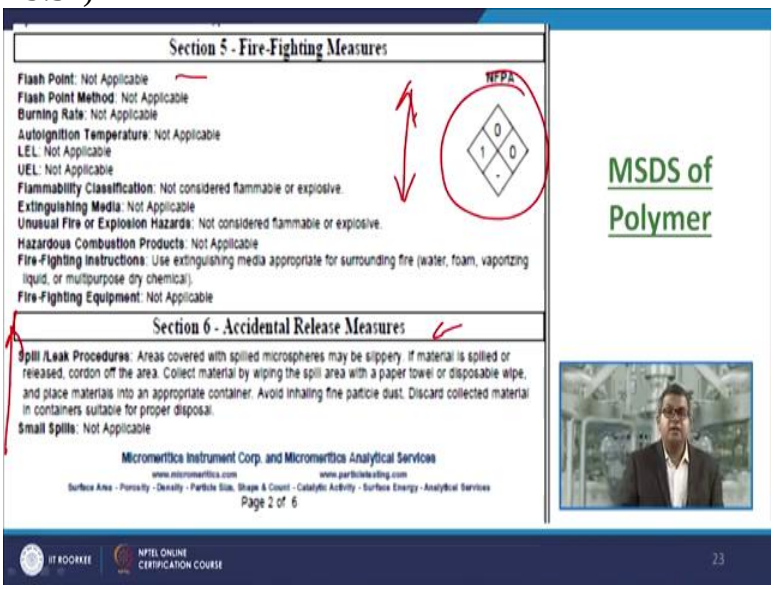

Then firefighting measures, if you go back to the previous one, the fire hazards, the minimum one, so what is NFPA rating? Flashpoint not applicable, Flashpoint method once it is not applicable, then there is no need to give the Flashpoint method, which method is being adopted, then burning rate etc. So, all these things, majority of things are not applicable to this particular segment.

Then the next section deals with the accidental release measures. So in case of any accident like a spill, leak, etc if it is there, then what kind of measures you need to adopt? Like area is covered

with a spill microspheres, may be slippery if material is spilled or released. Why this caution is given? Because sometimes if it is spilled over, then if it is slippery then it may create other problems, occupational illness, occupational injury etc. So, sometimes the fracture, sometimes pain may occur. So, this type of advisory is there.

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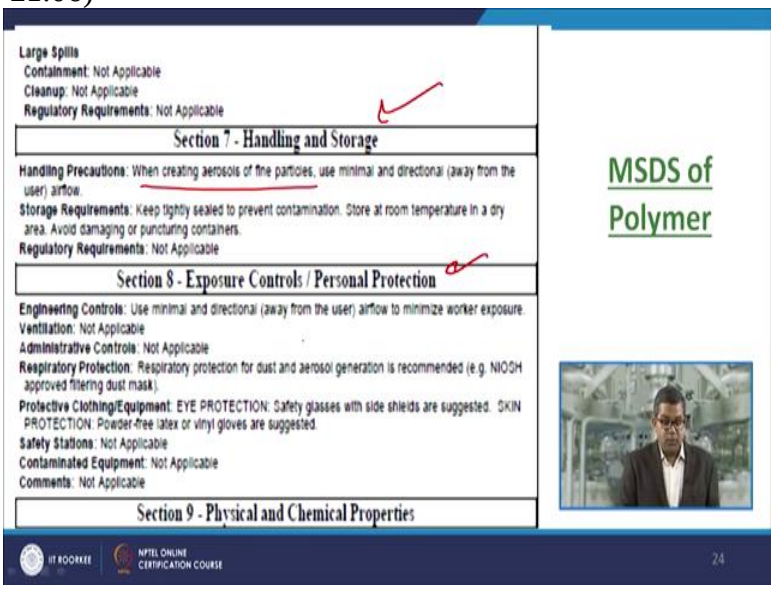

Then next section deals with the handling and storage, you must ensure that all kind of handling advisory storage requirement should be there, like handling precautions when creating aerosols or fine particles use minimal and directional away from airflow. Storage requirement keep tightly sealed to prevent contamination etc. Now, this is advisory for the use, not for the storage. So, whenever you are using it then and if for a very specific purpose, then you adopt this methodology.

Then the next section deals with the exposure control and personal protection, there are certain engineering controls use minimal and directional airflow, administrative control usually it is not applicable because relatively this particular chemical is safe. Respiratory protection for dust and aerosol generation because it is a very case sensitive, then protective clothing etc.

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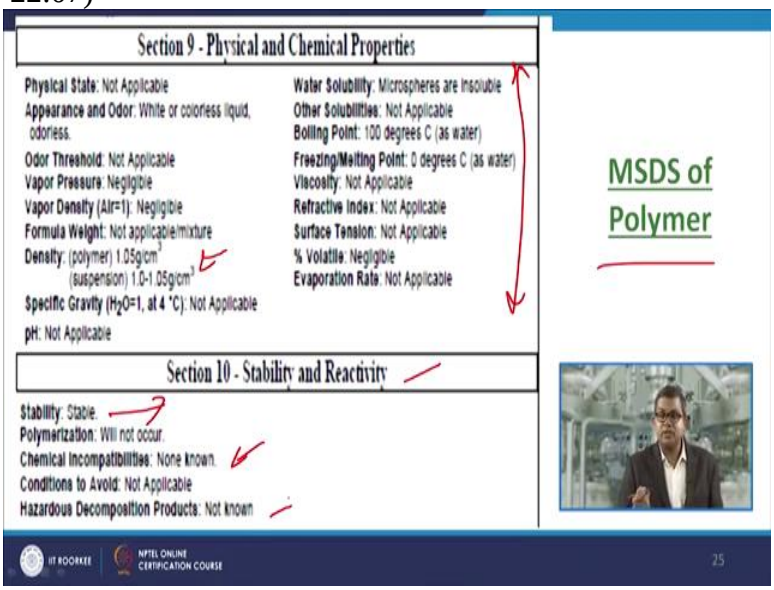

Then this is again a very important section that is a physical and the chemical properties, the physical state usually it is not applicable because it is a polymer. Then appearance, odor threshold, vapor pressure, vapor density, then density is there, then water solubility, other solubility etc. So, all kind of the maximum number of information, whatever you can provide or you can have. So all kind of things should be enlisted. Then you can see this section deals with the stability and reactivity data, usually it is a stable polymerization, it is not occur, chemical incompatibilities not known.

Sometimes if anybody encountered this type of problem, it may inform the manufacturer that this particular chemical is having incompatible with this type of scenario. So, in future they may enlist all those things, so condition to avoid it is not applicable because relatively it is a stable one. Then hazardous decomposition product, it is usually unknown.

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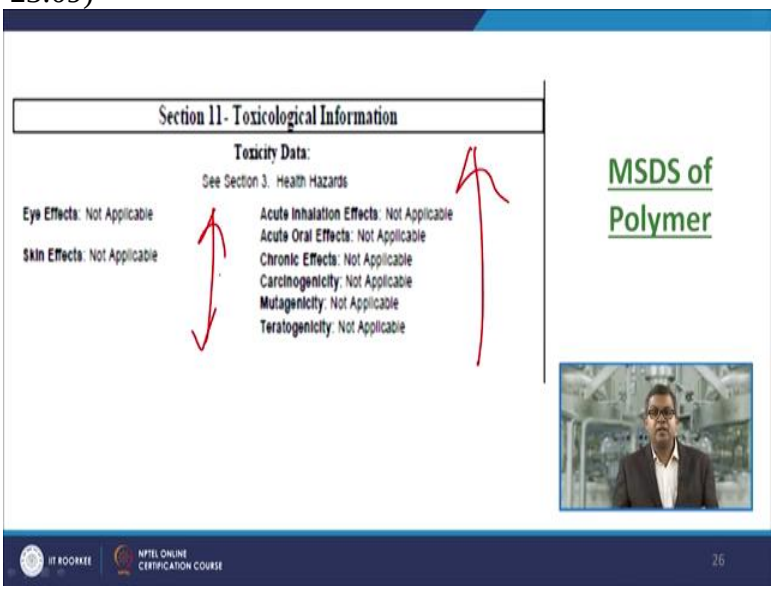

Then toxicological information, you can see that no, nothing is applicable because this particular chemical is relatively safe.

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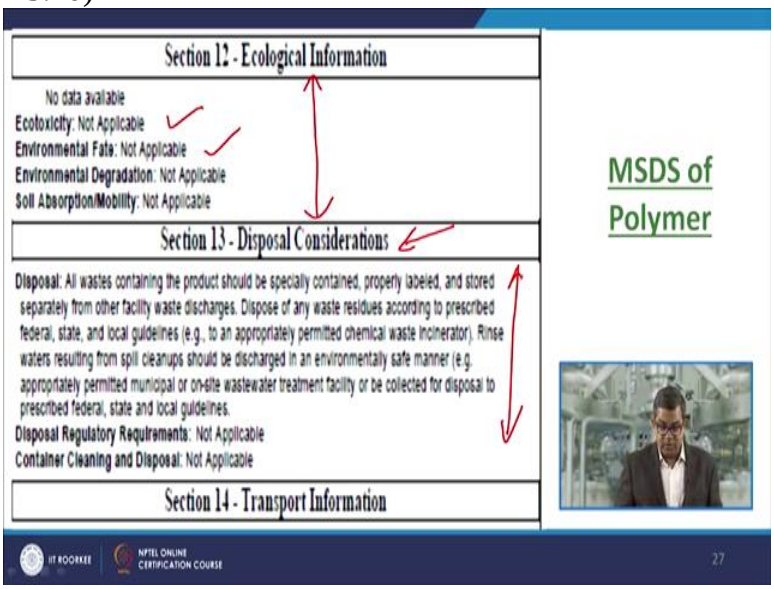

Then sometimes the MSDS manufacturer, they may provide the ecological information, this is usually related to the environment that what is eco-toxicity, environmental fate, etc. So, this type of information, essential information is provided. Then some this, this particular section is again important, you need to follow certain protocol for the safe disposal. Suppose unused or unreactive, then you need to enlist all kinds of procedure and protocol for the safe disposal.

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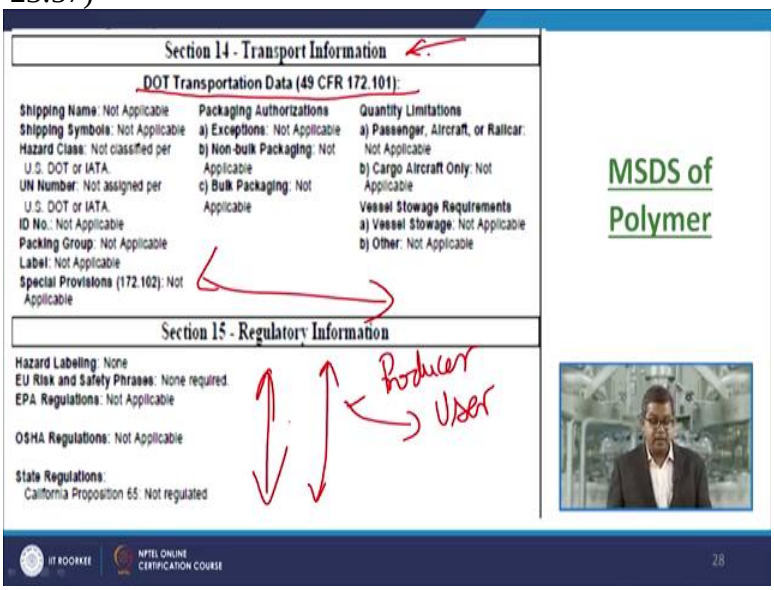

When all kind of transportation information is enlisted, now you can see the transportation protocol is mentioned over here. So, you need to follow that particular protocol for transportation of this particular chemical, like shipping name, shipping symbol, hazardous class, UN number, ID number etc. So all this information should be enlisted over here. Then regulatory information, which I discussed earlier that this not only deals with the for the producer, but also deals with the user. So you must know because ultimately whenever you are using that particular chemical, then if it is unreacted or unused, then you will dispose it to somewhere else.

So you must know that what kind of regulatory information and guidelines are available based on the central government law, based on the state government law. So all kind of things must be enlisted in this particular section.

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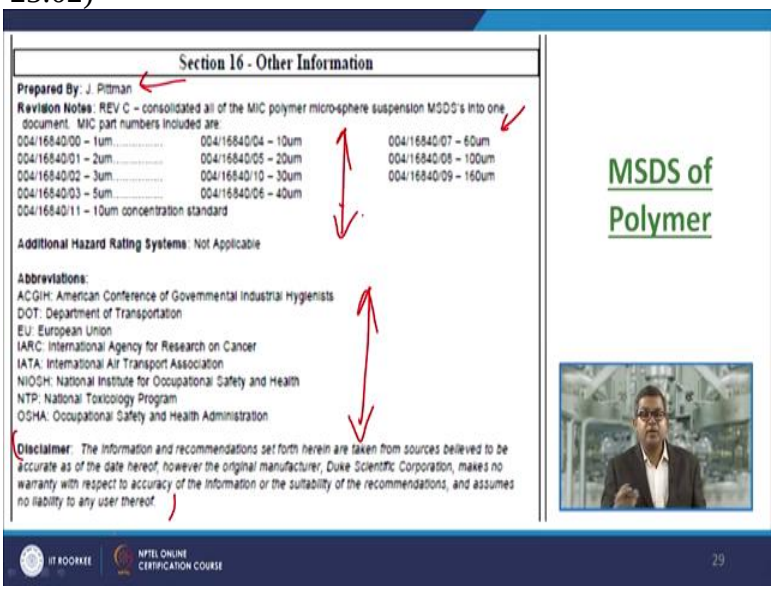

Now, you may enlist that other relevant information, one important information is that who prepared this MSDS? It is again essential because that person has to take the onus of that particular MSDS. Then whenever this MSDS being revised based on the product modification, based on the other regulatory compulsion, so it, this, this should also be listed. And this section deals with what kind of different abbreviation being used in preparation of this MSDS, so this type of abbreviations must be enlisted so that there should not be any confusion etc. And the last section is a very common one, the disclaimer. So everywhere you will find that this kind of disclaimer.

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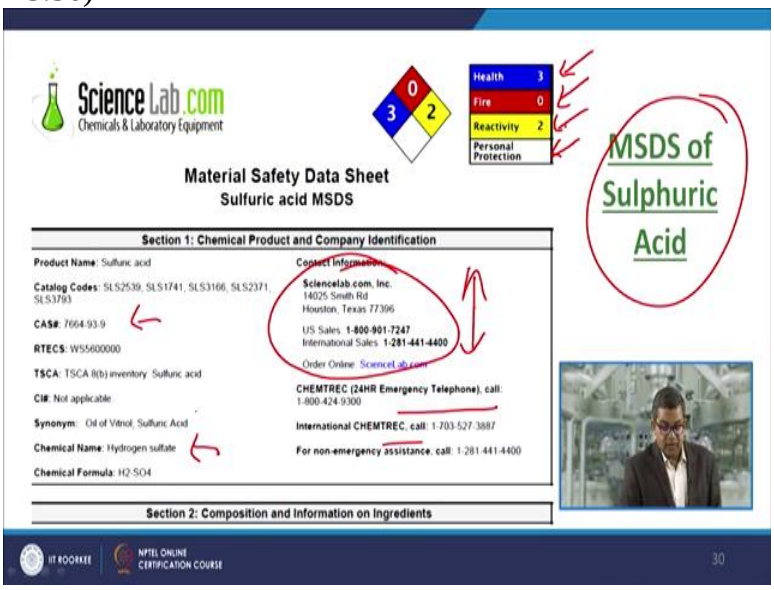

Now we have taken the example of one of the safest material that is MSDS of Polymer. Now, let us have a look of MSDS of sulfuric acid, now you can see that it is extremely hazardous though it is not having very higher tendency of fire, it is highly reactive, and you need to adopt the personal protective gears. So, now again, the first section deals with the product name, different type of catalog codes.

We can see that the CAS number is there and who has produced it or who has who has procured or prepared this MSDS and a component is there in case of emergency etc. So all kind of relevant information is there, the important thing is that different chemical name, that it is available in the name of hydrogen sulfate, the chemical formula is H_2SO_4 etc. This is there.

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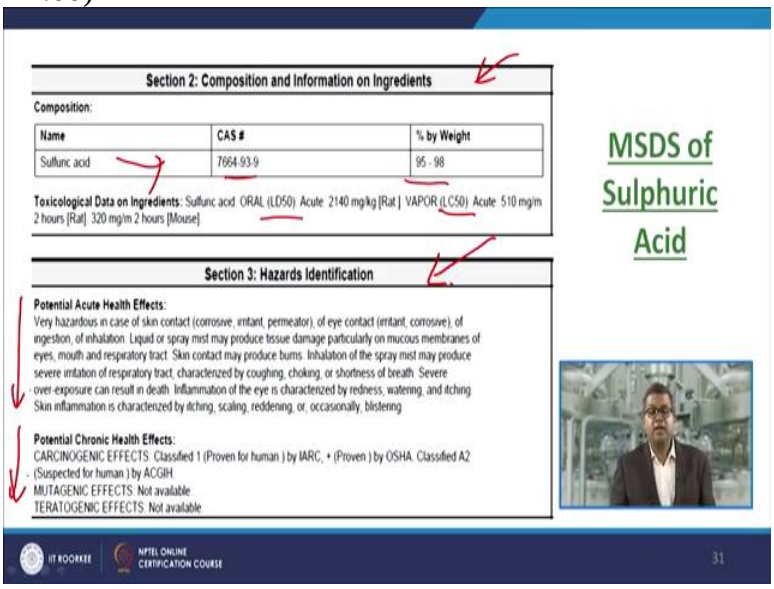

Now this section deals with the composition and other information, we are dealing with the pure sulfuric acid. So CAS number is there and 95 to 98 percent by weight minimum SA is there, other toxicological data related to the ingredient is also enlisted like LD50, LC50 et cetera. Then all other you can see that it is a very because it is extremely health hazardous. So all kind of essential data, essential information is available here. So in case of acute health effect, and in case of chronic health effects, so all kinds of information is there.

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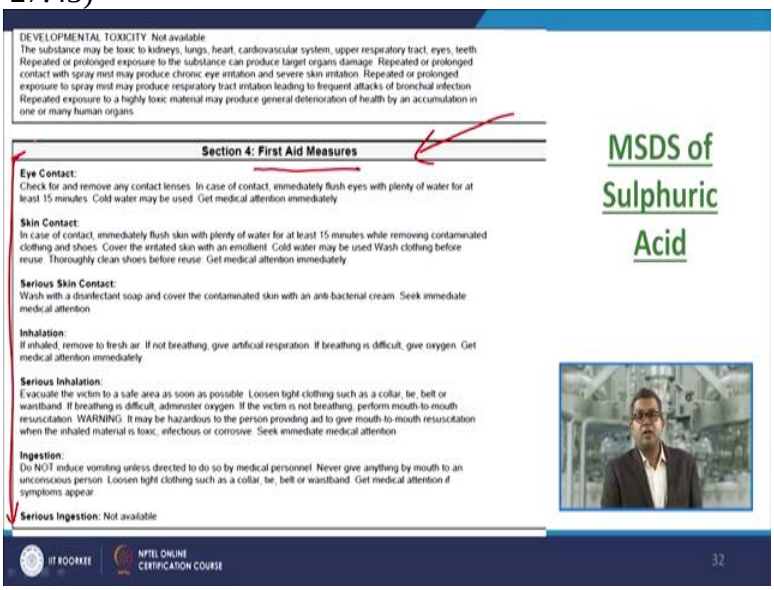

Since it is extremely dangerous or extremely hazardous, so first is measures, they all enlisted the different effects like eye contact, skin contact, serious skin contact, inhalation in case of inhalation, serious inhalation. So, they have listed all kind of information which they can provide.

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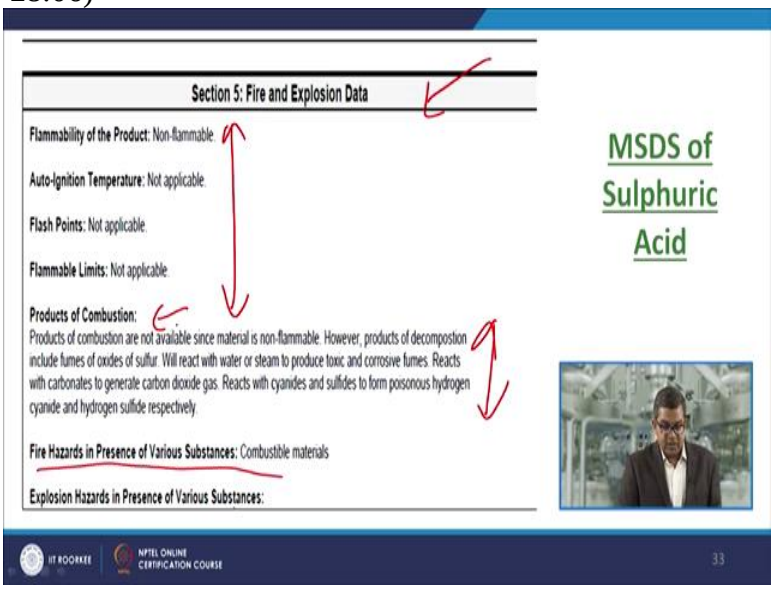

Since, it is usually non-flammable, then this particular section is not having much importance. So flammability of the product, non-flammable, auto-ignition temperature, because it is non-flammable, it is not applicable, Flashpoint flammable limits etc. These are not applicable. But related information related to the products of combustion is there.

So you cannot overlook this particular information, it may create fire hazard in the presence of various substances like combustible materials, explosion hazard in the presence of various substances.

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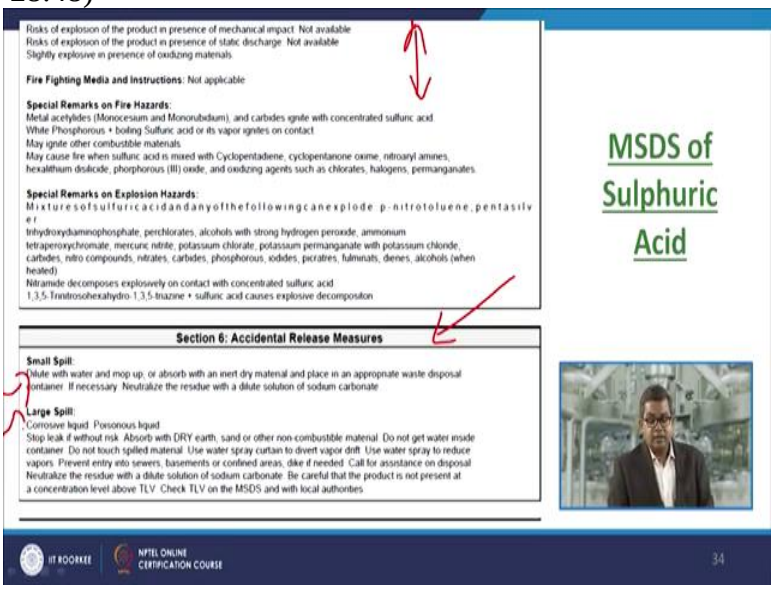

It is the information related to this particular aspect is given in the slide, then what kind of measures need to adopt in case of any accident? If there is any small spill, then large spill, so you can compare and you can see that this particular compound since the gravity of hazard is on the higher side, so you have to take certain measures to control the release of this sulfuric acid. So this particular MSDS gives a prima facie information that how hazardous this particular component is it.

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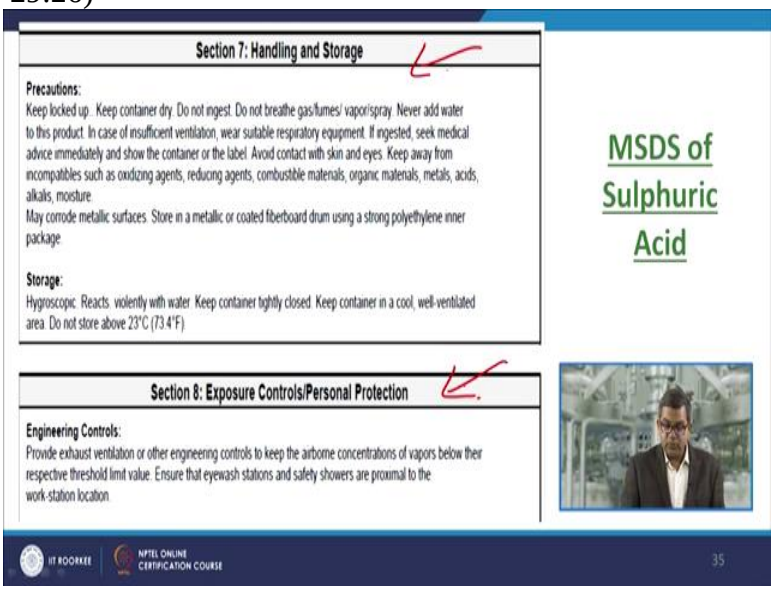

Like handling and storage, what kind of precautions you need to take during the handling and storage, what are the exposure controls and a personal protection you need to adopt like personal protection, face shield, full suits etc.

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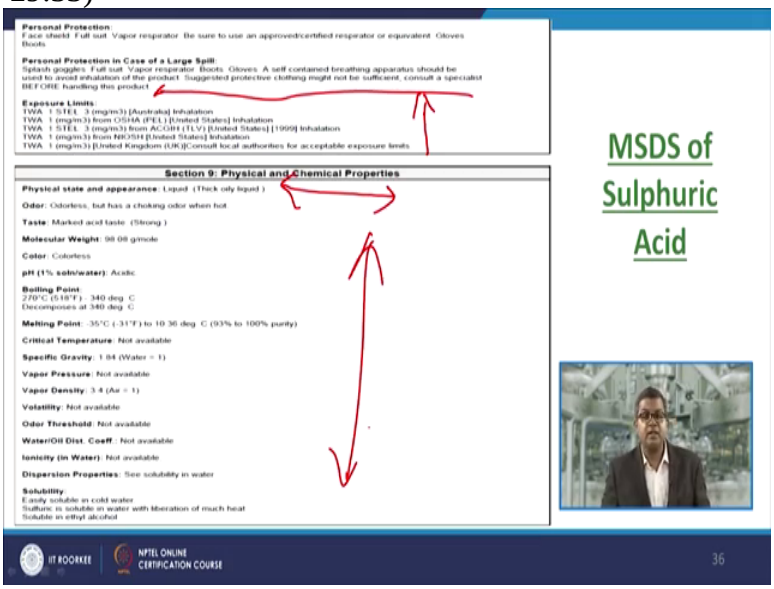

The personal protection in case of a large spill, what kind of things you need to adopt and various exposure limits, it is mentioned over here. Different chemical and physical properties like physical state, odorless taste, molecular weight, etc. So all kind of relevant information is enlisted over here.

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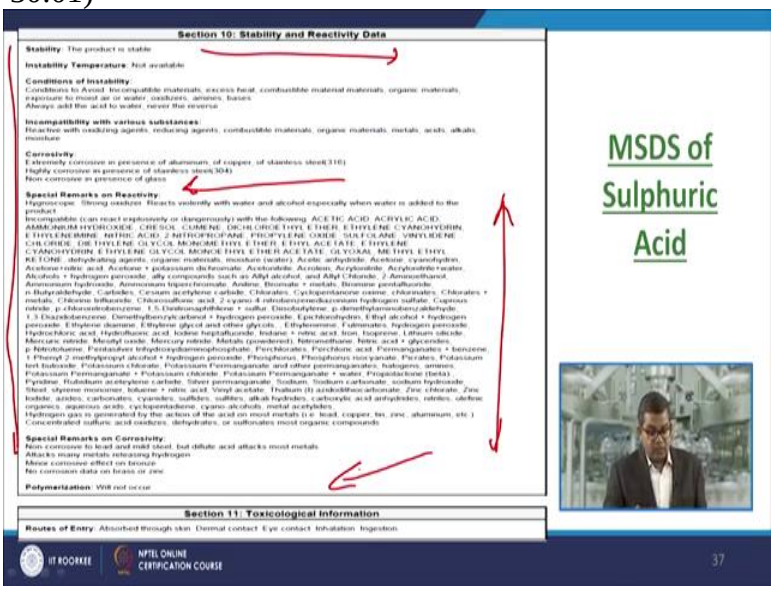

Now in this section, the stability because it is highly reactive in nature as listed in the pictorial diagram, then this type of information is extremely useful and then they, they gave the special remark on reactivity, that you need to be aware of this kind of situation and this particular thing because this is hygroscopic in natures, so a strong oxidizer. So this react violently with water, alcohol especially when water is added. So you need to take a due care. So, and sometimes the special remarks they have given for the corrosivity.

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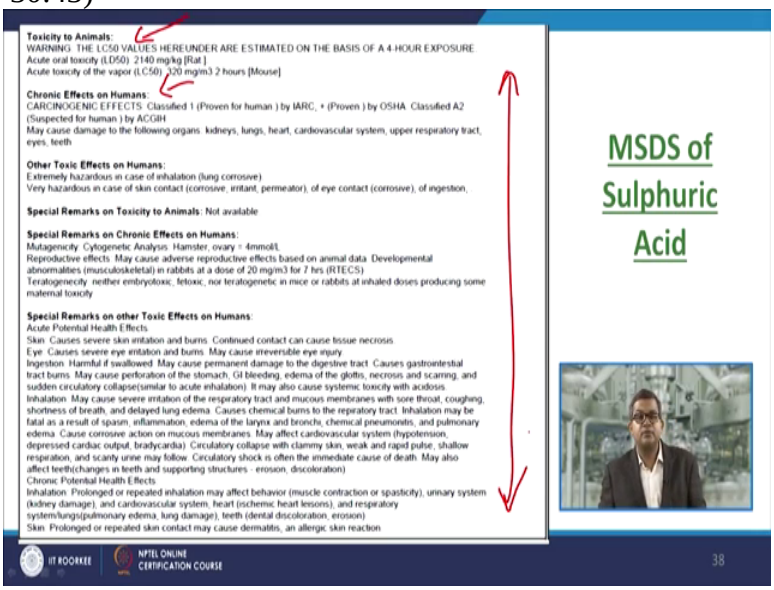

Then the toxicological information, usually they have given the information related to the toxicity to animal, then chronic effect on human, other toxic effects enlisted. So you can see that they have given a large number of information related to the toxicity of this H_2SO_4.

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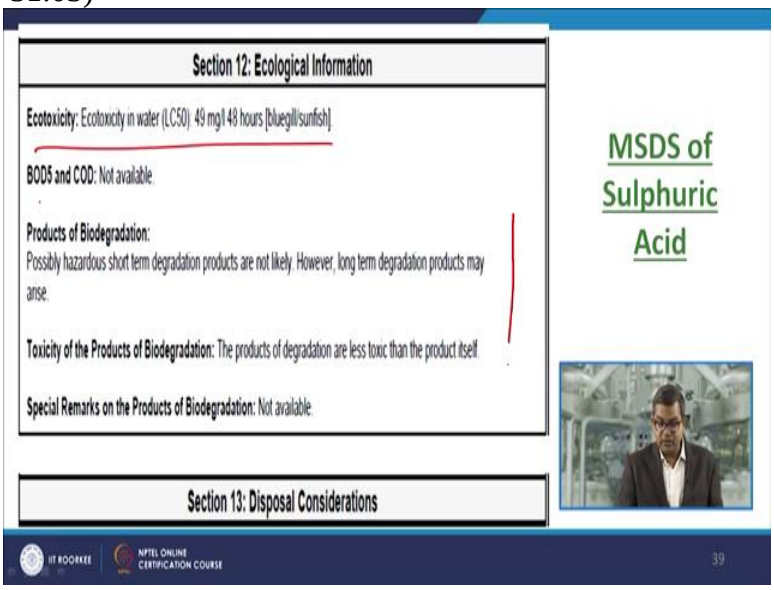

Then ecological information, so eco-toxicity, if you recall the previous one was not applicable, but here it is extremely toxic for ecological system. So eco-toxicity is mentioned, then product of biodegradation it is also mentioned.

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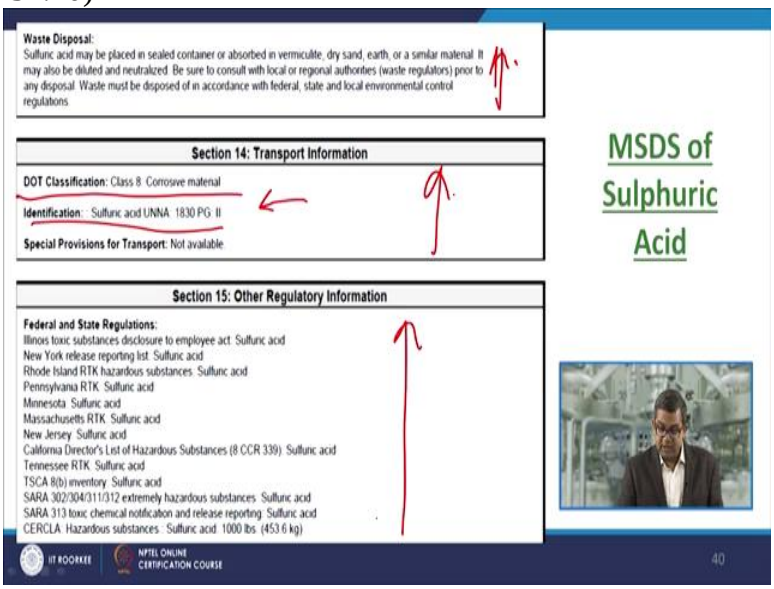

Then you, what kind of special consideration you need for ways to disposal, it is enlisted here. Because it is a very corrosive material, so they have given the transportation information, Department of Transportation, they gave the proper protocol for this one. The other relative regulatory information is enlisted in this section.

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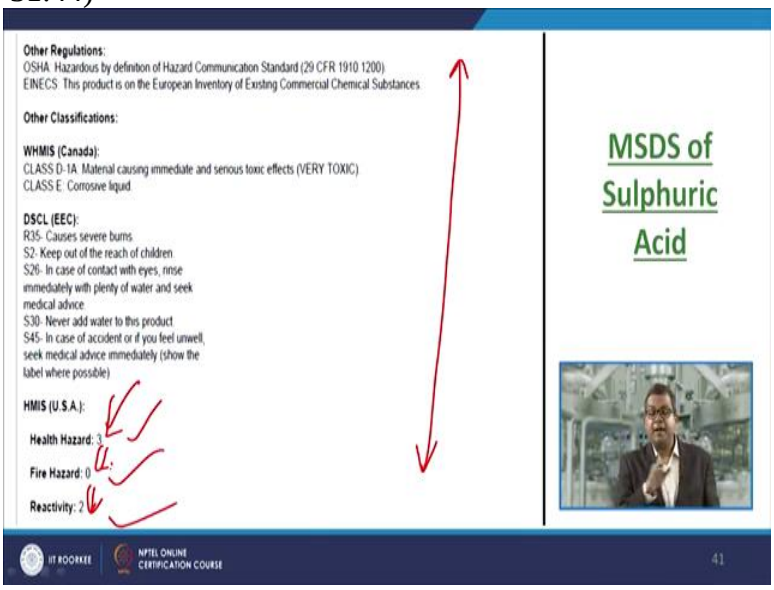

So in case of any problem, in case of anything, you may refer to those regulatory informations, health hazard data, fire hazard data, reactive data etc. So you may refer because if these number on the higher then you need to take the proper care and you need to adopt the proper controlled methodology for protection of your workers and environment outside.

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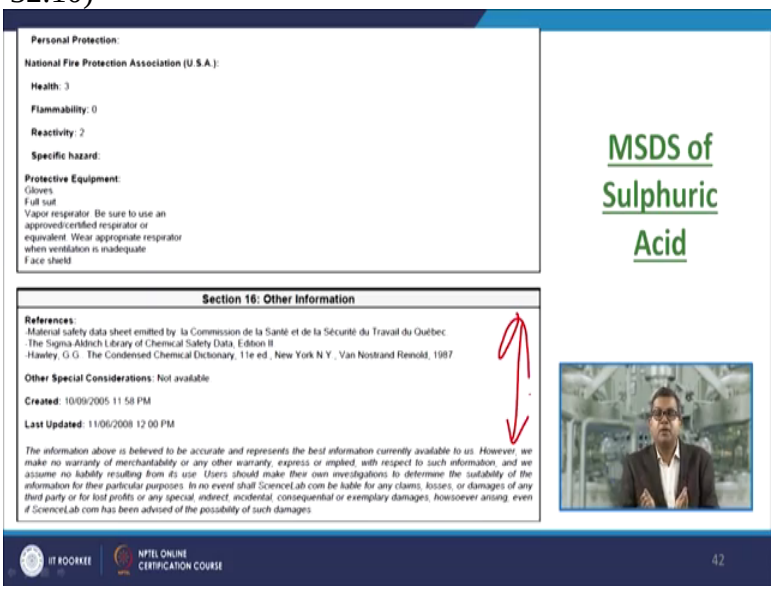

The other relevant information is also enlisted in the last section of this sulfuric acid MSDS, now and we have given a proper comparison with safest material to the extremely dangerous material so that you can see that what is the gravity of the information and how essential this information especially for designing the control measures.

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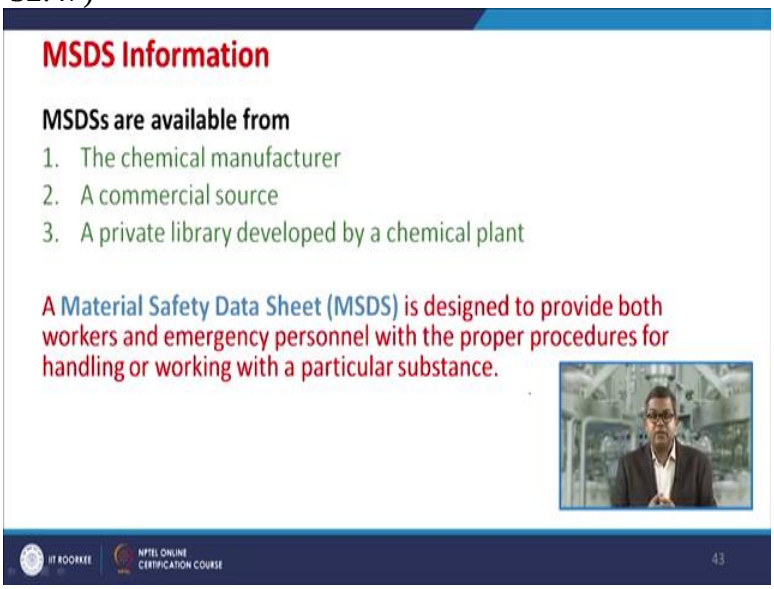

Now usually MSDS they are available from where you can get, this question is always comes in your mind that usually MSDS they are available from the chemical manufacturers, usually from a commercial source. Like I have taken it from the commercial source, a private library developed by a chemical plant etc., because if they are producing that chemical or they are using,

so based on their safety review, based on their information available, they are, they created this MSDS. So, Material Safety Data Sheet is designed to provide both worker and emergency personnel with the proper procedure for handling or working with a particular substance.

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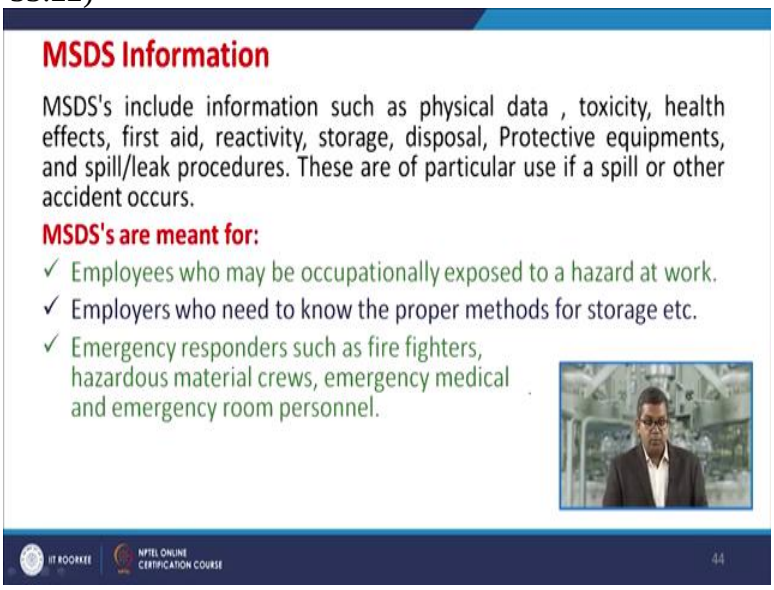

So MSDS include information such as physical data, toxicity etc. We have already gone through this one, now for whom we are using this MSDS? So MSDS are meant for employees those who may be occupationally exposed to hazard at work, employer who need to know the proper method of storage handling, etc. Emergency responders such as firefighters, hazardous material crews, emergency medical and emergency room personnel etc.

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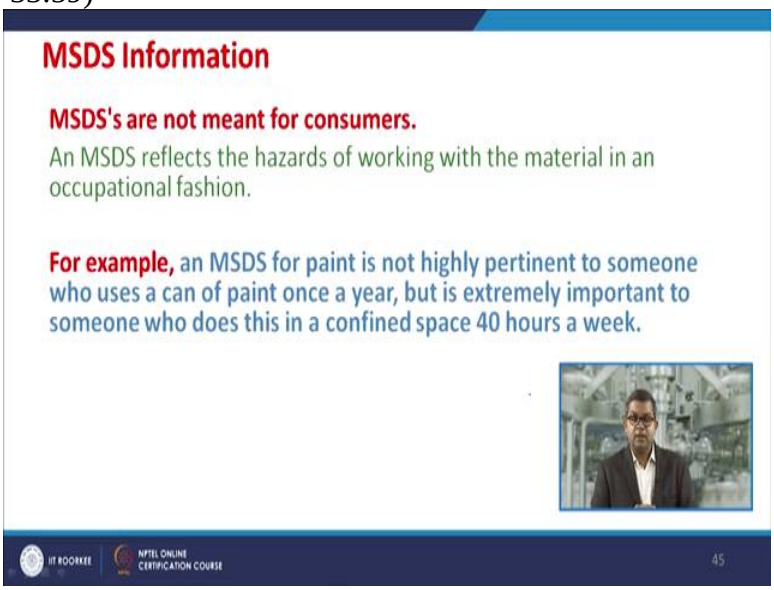

Now remember MSDS, they are not meant for the consumer, an MSDS reflects the hazard of working with the material in occupational fashion. For example, an MSDS for a paint is not highly pertinent to someone who uses a can of paint once in a year. But it is extremely important to someone who does it this particular work in a confined space for 40 hours a week. The reason is that he is in direct contact in an occupational manner. But if as a user I cannot adopt all kind of safety measures, if I am using that particular can of paint for once in a year or so, because ultimately it would be highly uneconomical for me.

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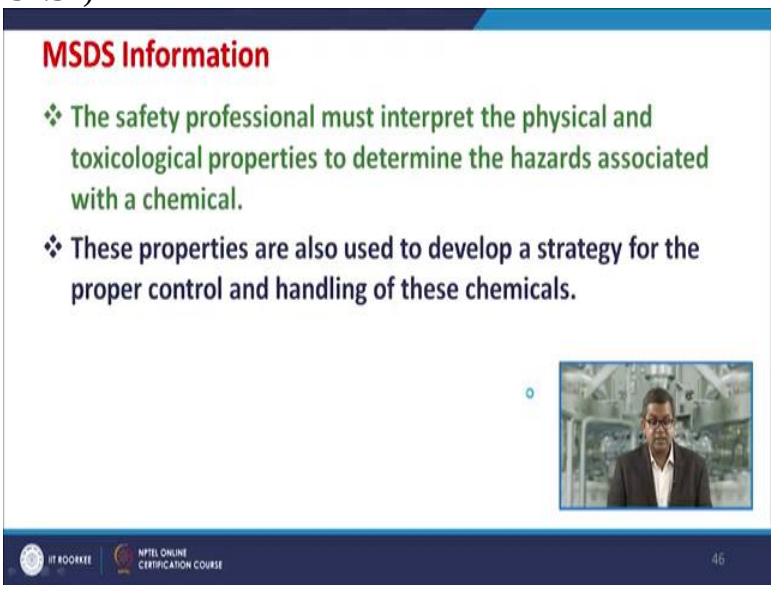

Now the safety professionals they must interpret the physical and toxicological properties to determine the hazards associated with the chemicals and these properties are also used to develop a strategy for the proper control and handling of these chemicals.

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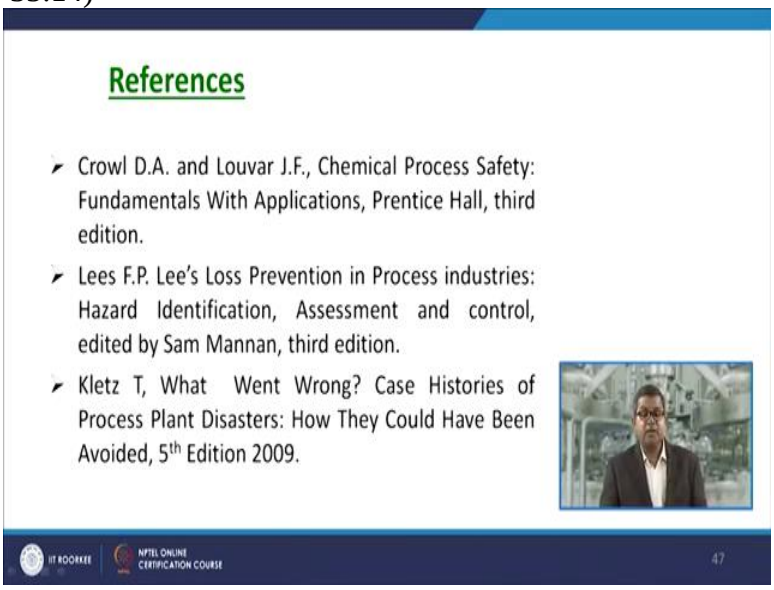

So in the future readings, you can use these references. So in this particular module, we have discussed all parts of MSDS with the two example, one example was the safe chemical, another example of the dangerous chemical and we discuss that for whom we should use the MSDS, from where we can have this MSDS. So by this word I am finishing up thanking you.