


**Chemical Process Safety**  
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**Lecture 12 - Material Safety Data Sheet – II**

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**What we have studied in last modules???**

- Introduction about Industrial Hygiene
- History
- Some Government Regulations
- Steps in Industrial Hygiene
- Material Safety Data Sheet



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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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## MSDS Information:

Sections:

- I. Product Identification
- II. Component Data (Hazardous Ingredients/Identity Info)
- III. Precautions For Safe Handling & Storage
- IV. Physical Data
- V. Personal Protective Equipment
- VI. Fire and Explosion Hazard Data
- VII. Reactivity Data

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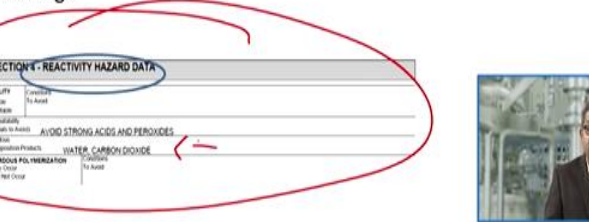
In the previous module, we have discussed partly the MSDS in terms of product identification, component data, precautions for various kind of safe handling and storage, physical data, boiling point etc, what kind of personal protective gears needed at workplace, fire and explosion hazard data.

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## MSDS Information: Section VII

### VII. Reactivity Data

- Includes information regarding the stability of the material and any special storage or use considerations
- Information may also be found in Section 3 Handling and Storage.



SECTION 7 - REACTIVITY HAZARD DATA	
<b>STABILITY</b>	Stability
<input checked="" type="checkbox"/> Stable	To Assess
<input type="checkbox"/> Unstable	
Reactivity	
Avoidance to Avoid	AVOID STRONG ACIDS AND PEROXIDES
Hazardous Polymerization	WATER, CARBON DIOXIDE
<input type="checkbox"/> None Known	To Assess
<input checked="" type="checkbox"/> Not Test Data	



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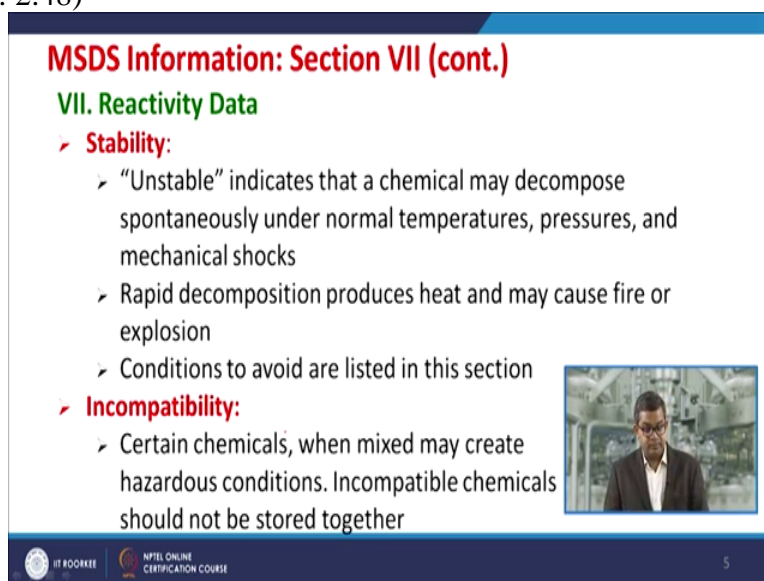
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Now in this particular module, we will discuss the remaining part of material safety data sheet and what are the, the other integral part of material safety data sheet. So, the section seven usually deals with the reactivity data; so supplier, manufacturer, 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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The slide is titled "MSDS Information: Section VII (cont.)" in red. Below the title is the section "VII. Reactivity Data" in green. It contains two main bullet points: "Stability:" and "Incompatibility:". The "Stability:" section has three sub-bullets: "Unstable" indicates that a chemical may decompose spontaneously under normal temperatures, pressures, and mechanical shocks; Rapid decomposition produces heat and may cause fire or explosion; Conditions to avoid are listed in this section. The "Incompatibility:" section has one sub-bullet: Certain chemicals, when mixed may create hazardous conditions. Incompatible chemicals should not be stored together. There is a small inset image of a man in a lab coat in the bottom right corner of the slide content area. The slide footer includes the IIT Bombay logo, "NPTEL ONLINE CERTIFICATION COURSE", and the number 5.

**MSDS Information: Section VII (cont.)**

**VII. Reactivity Data**

- **Stability:**
  - "Unstable" indicates that a chemical may decompose spontaneously under normal temperatures, pressures, and mechanical shocks
  - Rapid decomposition produces heat and may cause fire or explosion
  - Conditions to avoid are listed in this section
- **Incompatibility:**
  - Certain chemicals, when mixed may create hazardous conditions. Incompatible chemicals should not be stored together


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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**MSDS Information: Section VII (cont.)**

**VII. Reactivity Data**

- **Decomposition Products:** Chemical substances which may be created when the chemical decomposes or burns
- **Polymerization:** Chemical reaction in which smaller molecular constituents combine with themselves to form larger, long-chain molecular structures. Rapid polymerization may produce enough heat to cause containers to explode



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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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**MSDS Information: Section VIII**  
**VIII. First Aid**

- Describes first aid procedures to be taken in the event of an exposure
- Caution needs to be exercised so that those applying first aid do not become exposed to the material for which they are attempting treatment
- In the event of an exposure, request medical assistance





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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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**MSDS Information: Section IX**  
**IX. Toxicology and Health Hazard Data**

- Defines the medical signs and symptoms that may be encountered with normal exposure or overexposure to the material or its components
- Information on the toxicity of the substance may also be presented



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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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**MSDS Information: Section IX (cont.)**

**IX. Toxicology and Health Hazard Data**

- **Acute Effect:** An adverse effect on a human or animal body resulting from a single exposure with symptoms developing almost immediately or shortly after exposure
- **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



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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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**MSDS Information: Section IX (cont.)**

**IX. Toxicology and Health Hazard Data**

- **Corrosive:** A liquid or solid that causes visible destruction or irreversible alterations in human skin tissue
- **Irritation:** An inflammatory response or reaction of the eye, skin or respiratory system
- **Allergic sensitization:** A process whereby on first exposure a substance causes little or no reaction, but upon repeated exposure may cause a marked adverse response



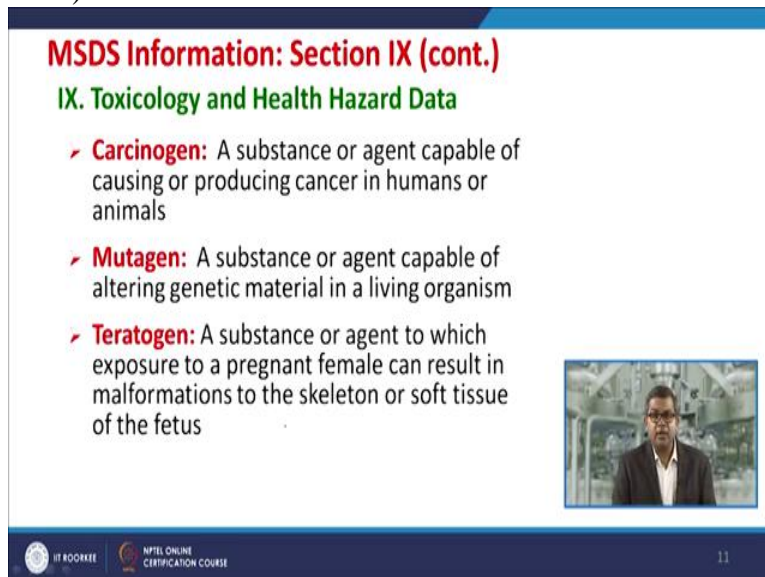
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Apart from this, the things like corrosiveness, irritation, allergic sensitization, etc. Now corrosive, a liquid or solid that causes visible destruction or irreversible alteration in the human



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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A presentation slide titled "MSDS Information: Section IX (cont.)" with a subtitle "IX. Toxicology and Health Hazard Data". It lists three types of hazards: Carcinogen, Mutagen, and Teratogen, each with a definition. A small video inset shows a man in a lab coat. The slide footer includes logos for IIT ROORKEE and NPTEL ONLINE CERTIFICATION COURSE, and the number 11.

**MSDS Information: Section IX (cont.)**

**IX. Toxicology and Health Hazard Data**

- **Carcinogen:** A substance or agent capable of causing or producing cancer in humans or animals
- **Mutagen:** A substance or agent capable of altering genetic material in a living organism
- **Teratogen:** A substance or agent to which exposure to a pregnant female can result in malformations to the skeleton or soft tissue of the fetus

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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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**MSDS Information: Section IX (cont.)**  
**IX. Toxicology and Health Hazard Data**

Results of animal studies are most often given.

- **LD50 (lethal dose 50):** is the dose of a substance which will cause the death of 50% of the experimental animals
- **LC50 (lethal concentration 50):** is the concentration of the substance in air which will cause the death of 50% of the experimental animals




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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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**MSDS Information: Section IX (cont.)**  
**IX. Toxicology and Health Hazard Data**

- **LD<sub>10</sub> (Lethal Dose Low):** The lowest dose of a substance introduced by any route other than inhalation reported to have caused death in humans or animals
- **LC<sub>10</sub> (Lethal Concentration Low):** The lowest concentration of a substance in air that has been reported to have caused death in humans or animals



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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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**MSDS Information: Section IX (cont.)**  
**IX. Toxicology and Health Hazard Data**

- **TD<sub>LO</sub> (Toxic Dose Low):** The lowest dose of a substance to which humans or animals have been exposed and reported to produce a toxic affect other than cancer.
- Based upon LD<sub>50</sub>, LC<sub>50</sub>, LD<sub>LO</sub>, LC<sub>LO</sub> and TD<sub>LO</sub>, an estimate of the potential effects on human health is obtained.




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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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**MSDS Information: Section X**  
**X. Transportation Data**

- This section contains information pertinent to DOT (Department of Transportation) regulations governing the transport of hazardous materials. These regulations can be found in 49 CFR parts 100 to 177.
- Please contact EHS&RM (474-5617 or 474-6771) if more information is needed or if shipping hazardous materials.



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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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**MSDS Information: Section XI**

**XI. Spill and Leak Procedures**

- Outlines general procedures, precautions and methods for cleanup of spills.
- Clean-up procedures for spills and leaks of hazardous materials are governed by a number of regulatory agencies.
- Do not put yourself or others at risk if you are not trained or equipped to clean-up a spill. Contact EHS&RM for assistance or to report a spill.



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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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**MSDS Information: Section XII**

**XII. Waste Disposal Data**

- Contains guidelines for the disposal of the product or product container if it becomes a waste.
- Hazardous waste is regulated by the EPA, (Environmental Protection Agency) under RCRA (Resource Conservation Recovery Act) regulations found in 40 CFR parts 260-272.
- Provisions for civil and criminal penalties for the improper storage and disposal of hazardous waste are included in these regulations.



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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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**MSDS Information: Section XIII**

**XIII. Additional Regulatory Information**

- Contains information relevant to compliance with other Federal or state laws such as:
  - TSCA** (Toxic Substances Control Act),
  - FIFRA** (Federal Insecticide, Fungicide, Rodenticide Act), and others.



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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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**MSDS Information: Section XIV & XV**

**XIV. Additional Information**

- This section, if present, will contain additional information regarding the product, which was not indicated in previous sections.

**XV. MAJOR REFERENCES**

- Lists some of the major references that have been consulted in preparation of the MSDS.

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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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**Material Safety Data Sheet**  
Most important reference used during an Industrial Hygiene study involving toxic chemicals.

**Micromeritics Material Safety Data Sheet**

Title : MSDS, Polymer Micro-sphere Suspension      MSDS No. : 004/16840/00MSDS  
Date of Preparation : 08/11/2006      Revision : C

**Section 1 - Chemical Product and Company Identification**

**Product/Chemical Name:** Polymer Microsphere Suspension  
**Chemical Formula:**  $(C_6H_5)_x + H_2O + \text{Proprietary}$   
**CAS Number:** Not Applicable  
**Other Designations:** Not Applicable  
**General Use:** Standard Particles

**Supplier:** Micromeritics Instrument Corp.  
 1 Micromeritics Dr.  
 Norcross, GA 30093-1877 USA  
**Manufacturer:** Duke Scientific Corporation, 2463 Faber Place, P.O. Box 50005, Palo Alto, CA, 94303  
 1-800-334-3883 or 1-650-424-1177, Fax: 1-650-424-1158, www.dukescientific.com, e-mail: info@dukesci.com

**Contact:** Human Resources  
 Phone: (770) 662-3620  
 Fax: (770) 662-3696

**Section 2 - Composition / Information on Ingredients**

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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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**Section 2 - Composition / Information on Ingredients**

Ingredient Name	CAS Number	%
polystyrene or polystyrene divinylbenzene	9003-53-6	<0.1-10 (varies dependent on product)
water	7732-18-5	90-99.9+
dispersant/surfactant	Proprietary	<0.5 (if any)
preservative	Proprietary	<0.1 (if any)

**Contents:** Solid polymer microspheres suspended in water. Polymers include polystyrene, polystyrene divinylbenzene (PSDVB), or other styrene copolymers.  
**NOTE:** This MSDS addresses potential worker health and safety issues associated with the handling of the final product (i.e., during its transportation, distribution, and use).  
**Trace Impurities:** Not Applicable

Ingredient	OSHA PEL		ACGIH TLV		NIOSH REL		NIOSH IDLH
	TWA	STEL	TWA	STEL	TWA	STEL	
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

See Section 3 for Occupational Exposure Limit

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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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**Section 3 - Hazards Identification**

\*\*\*\*\* **Emergency Overview** \*\*\*\*\*

**Potential Health Effects**  
Primary Entry Routes: Inhalation, accidental ingestion, skin or eye contact.  
Target Organs: Not Applicable  
**Acute Effects**  
Inhalation: CAUTION: May cause lung irritation if inhaled. SYSTEMIC: If inhaled in large quantities, may cause reversible lung irritation.  
Eye: No data available. If suspension contacts eye, may cause reversible irritation.  
Skin: No data available. If suspension contacts skin, may cause reversible irritation.  
Ingestion: Not Applicable  
Carcinogenicity: Ingredients are not listed by NTP, IARC or OSHA as carcinogens.  
Medical Conditions Aggravated by Long-Term Exposure: None known.  
Chronic Effects: SYSTEMIC: If inhaled in large quantities, may cause reversible lung irritation.  
Reproductive And Developmental Toxicity: Ingredients are not considered reproductive or developmental toxicants.  
Occupational Exposure Limit: None established by OSHA, ACGIH or Duke Scientific Corporation.

**Section 4 - First Aid Measures**

Inhalation: Remove to fresh air and seek medical advice.  
Eye Contact: Wash thoroughly with water. If an irritation develops, seek medical advice.  
Skin Contact: Wash thoroughly with soap and water. If an irritation develops, seek medical advice.  
Ingestion: Give one to two glasses of water and seek medical advice.  
Note to Physicians: Not Applicable  
Special Precautions/Procedures: Not Applicable

**MSDS of Polymer**

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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 carcinogenicity, 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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The screenshot displays a portion of a Material Safety Data Sheet (MSDS) for a polymer. It is divided into two main sections: 'Section 5 - Fire-Fighting Measures' and 'Section 6 - Accidental Release Measures'. In the fire-fighting section, various properties are listed as 'Not Applicable', including Flash Point, Burning Rate, Autoignition Temperature, LEL, UEL, Flammability Classification, Extinguishing Media, and Unusual Fire or Explosion Hazards. A red circle highlights the NFPA hazard diamond, which shows a 0 in the blue section (Health), a 1 in the red section (Flammability), and a 0 in the yellow section (Reactivity). The fire-fighting instructions specify using water, foam, or vaporizing liquid, or multipurpose dry chemical. The accidental release section provides spill/leak procedures, such as cordoning off the area and using paper towels for cleanup. The slide also features a small video inset of a presenter and a footer with logos for IIT ROORKEE and NPTEL ONLINE CERTIFICATION COURSE, along with the page number 23.

**Section 5 - Fire-Fighting Measures**

Flash Point: Not Applicable  
Flash Point Method: Not Applicable  
Burning Rate: Not Applicable  
Autoignition Temperature: Not Applicable  
LEL: Not Applicable  
UEL: Not Applicable  
Flammability Classification: Not considered flammable or explosive.  
Extinguishing Media: Not Applicable  
Unusual Fire or Explosion Hazards: Not considered flammable or explosive.  
Hazardous Combustion Products: Not Applicable  
Fire-Fighting Instructions: Use extinguishing media appropriate for surrounding fire (water, foam, vaporizing liquid, or multipurpose dry chemical).  
Fire-Fighting Equipment: Not Applicable

**Section 6 - Accidental Release Measures**

Spill/Leak Procedures: Areas covered with spilled microspheres may be slippery. If material is spilled or released, cordon off the area. Collect material by wiping the spill area with a paper towel or disposable wipe, and place materials into an appropriate container. Avoid inhaling fine particle dust. Discard collected material in containers suitable for proper disposal.  
Small Spills: Not Applicable

**MSDS of Polymer**

Micromeritics Instrument Corp. and Micromeritics Analytical Services  
www.micromeritics.com  
www.particle sizing.com  
Surface Area - Porosity - Density - Particle Size, Shape & Count - Catalytic Activity - Surface Energy - Analytical Services  
Page 2 of 6

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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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Large Spills  
Containment: Not Applicable  
Cleanup: Not Applicable  
Regulatory Requirements: Not Applicable

**Section 7 - Handling and Storage**

Handling Precautions: When creating aerosols of fine particles, use minimal and directional (away from the user) airflow.  
Storage Requirements: Keep tightly sealed to prevent contamination. Store at room temperature in a dry area. Avoid damaging or puncturing containers.  
Regulatory Requirements: Not Applicable

**Section 8 - Exposure Controls / Personal Protection**

Engineering Controls: Use minimal and directional (away from the user) airflow to minimize worker exposure.  
Ventilation: Not Applicable  
Administrative Controls: Not Applicable  
Respiratory Protection: Respiratory protection for dust and aerosol generation is recommended (e.g. NIOSH approved filtering dust mask).  
Protective Clothing/Equipment: EYE PROTECTION: Safety glasses with side shields are suggested. SKIN PROTECTION: Powder-free latex or vinyl gloves are suggested.  
Safety Stations: Not Applicable  
Contaminated Equipment: Not Applicable  
Comments: Not Applicable

**Section 9 - Physical and Chemical Properties**

MSDS of Polymer

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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.

(Refer Slide Time: 22:07)

**Section 9 - Physical and Chemical Properties**

Physical State: Not Applicable	Water Solubility: Microspheres are insoluble
Appearance and Odor: White or colorless liquid, odorless.	Other Solubilities: Not Applicable
Odor Threshold: Not Applicable	Boiling Point: 100 degrees C (as water)
Vapor Pressure: Negligible	Freezing/Melting Point: 0 degrees C (as water)
Vapor Density (Air=1): Negligible	Viscosity: Not Applicable
Formula Weight: Not applicable/mixture	Refractive Index: Not Applicable
Density: (polymer) 1.05g/cm <sup>3</sup> (suspension) 1.0-1.05g/cm <sup>3</sup>	Surface Tension: Not Applicable
Specific Gravity (H <sub>2</sub> O=1, at 4 °C): Not Applicable	% Volatile: Negligible
pH: Not Applicable	Evaporation Rate: Not Applicable

**Section 10 - Stability and Reactivity**

Stability: Stable
Polymerization: Will not occur.
Chemical Incompatibilities: None known.
Conditions to Avoid: Not Applicable
Hazardous Decomposition Products: Not known

**MSDS of Polymer**

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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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**Section 11 - Toxicological Information**

**Toxicity Data:**  
See Section 3. Health Hazards

Eye Effects: Not Applicable  
Skin Effects: Not Applicable  
Acute Inhalation Effects: Not Applicable  
Acute Oral Effects: Not Applicable  
Chronic Effects: Not Applicable  
Carcinogenicity: Not Applicable  
Mutagenicity: Not Applicable  
Teratogenicity: Not Applicable

**MSDS of Polymer**

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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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**Section 12 - Ecological Information**

No data available  
Ecotoxicity: Not Applicable  
Environmental Fate: Not Applicable  
Environmental Degradation: Not Applicable  
Soil Absorption/Mobility: Not Applicable

**Section 13 - Disposal Considerations**

Disposal: All wastes containing the product should be specially contained, properly labeled, and stored separately from other facility waste discharges. Dispose of any waste residues according to prescribed federal, state, and local guidelines (e.g., to an appropriately permitted chemical waste incinerator). Rinse waters resulting from spill cleanups should be discharged in an environmentally safe manner (e.g., appropriately permitted municipal or on-site wastewater treatment facility) or be collected for disposal to prescribed federal, state and local guidelines.  
Disposal Regulatory Requirements: Not Applicable  
Container Cleaning and Disposal: Not Applicable

**Section 14 - Transport Information**

**MSDS of Polymer**

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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.

(Refer Slide Time: 23:57)


Section 14 - Transport Information		
<u>DOT Transportation Data (49 CFR 172.101):</u>		
Shipping Name: Not Applicable	Packaging Authorizations	Quantity Limitations
Shipping Symbols: Not Applicable	a) Exceptions: Not Applicable	a) Passenger, Aircraft, or Railroad: Not Applicable
Hazard Class: Not classified per U.S. DOT or IATA	b) Non-bulk Packaging: Not Applicable	b) Cargo Aircraft Only: Not Applicable
UN Number: Not assigned per U.S. DOT or IATA	c) Bulk Packaging: Not Applicable	Vessel Stowage Requirements
ID No.: Not Applicable		a) Vessel Stowage: Not Applicable
Packing Group: Not Applicable		b) Other: Not Applicable
Label: Not Applicable		
Special Provisions (172.102): Not Applicable		

Section 15 - Regulatory Information
Hazard Labeling: None
EU Risk and Safety Phrases: None required
EPA Regulations: Not Applicable
OSHA Regulations: Not Applicable
State Regulations: California Proposition 65: Not regulated

*Handwritten notes:* A red arrow points from the "Special Provisions" field to the "Regulatory Information" section. Two vertical red arrows are drawn between the "Regulatory Information" section and the "Producer" and "User" labels. The word "Producer" is written in red above the right arrow, and "User" is written in red below the right arrow.

**MSDS of Polymer**



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.



(Refer Slide Time: 25:02)

### Section 16 - Other Information

**Prepared By:** J. Pittman

**Revision Notes:** REV C - consolidated all of the MIC polymer micro-sphere suspension MSDS's into one document. MIC part numbers included are:


004/16840/00 - 1um	004/16840/04 - 10um	004/16840/07 - 60um
004/16840/01 - 2um	004/16840/05 - 20um	004/16840/08 - 100um
004/16840/02 - 3um	004/16840/10 - 30um	004/16840/09 - 160um
004/16840/03 - 5um	004/16840/06 - 40um	
004/16840/11 - 10um concentration standard		



**Additional Hazard Rating Systems:** Not Applicable

**Abbreviations:**  
ACGIH: American Conference of Governmental Industrial Hygienists  
DOT: Department of Transportation  
EU: European Union  
IARC: International Agency for Research on Cancer  
IATA: International Air Transport Association  
NIOSH: National Institute for Occupational Safety and Health  
NTP: National Toxicology Program  
OSHA: Occupational Safety and Health Administration

**Disclaimer:** The information and recommendations set forth herein are taken from sources believed to be accurate as of the date hereof; however the original manufacturer, Duke Scientific Corporation, makes no warranty with respect to accuracy of the information or the suitability of the recommendations, and assumes no liability to any user thereof.

**MSDS of Polymer**





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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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Health	3
Fire	0
Reactivity	2
Personal Protection	

**MSDS of Sulphuric Acid**



### Material Safety Data Sheet

#### Sulfuric acid MSDS

#### Section 1: Chemical Product and Company Identification

<b>Product Name:</b> Sulfuric acid <b>Catalog Codes:</b> SLS2539, SLS1741, SLS3166, SLS2371, SLS3793 <b>CAS#:</b> 7664-93-9 <b>RTECS:</b> W55600000 <b>TSCA:</b> TSCA (b)(1) inventory: Sulfuric acid <b>CMR:</b> Not applicable <b>Synonym:</b> Oil of Vitrol, Sulfuric Acid <b>Chemical Name:</b> Hydrogen sulfate <b>Chemical Formula:</b> H <sub>2</sub> SO <sub>4</sub>	<b>Contact Information:</b> <b>Sciencelab.com, Inc.</b> 14025 Smith Rd Houston, Texas 77396 <b>US Sales:</b> 1-800-901-7247 <b>International Sales:</b> 1-281-441-4400 <b>Order Online:</b> <a href="http://Sciencelab.com">Sciencelab.com</a> <b>CHEMTREC (24HR Emergency Telephone):</b> call: 1-800-424-9300 <b>International CHEMTREC:</b> call: 1-703-527-3887 <b>For non-emergency assistance:</b> call: 1-281-441-4400
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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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**Section 2: Composition and Information on Ingredients**

Composition:

Name	CAS #	% by Weight
Sulfuric acid	7664-93-9	95 - 98

Toxicological Data on Ingredients: Sulfuric acid, ORAL (LD50) Acute: 2140 mg/kg [Rat] VAPOR (LC50) Acute: 510 mg/m 2 hours [Rat] 320 mg/m 2 hours [Mouse]

**Section 3: Hazards Identification**

**Potential Acute Health Effects:**  
 Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

**Potential Chronic Health Effects:**  
 CARCINOGENIC EFFECTS: Classified 1 (Proven for human) by IARC, \* (Proven) by OSHA. Classified A2 (Suspected for human) by ACGIH.  
 MUTAGENIC EFFECTS: Not available  
 TERATOGENIC EFFECTS: Not available

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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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DEVELOPMENTAL TOXICITY: Not available  
The substance may be toxic to kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

### Section 4: First Aid Measures

**Eye Contact:**  
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

**Skin Contact:**  
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

**Serious Skin Contact:**  
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.


**Inhalation:**  
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

**Serious Inhalation:**  
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. **WARNING:** It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

**Ingestion:**  
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

**Serious Ingestion:** Not available.

**MSDS of Sulphuric Acid**



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Since it is extremely dangerous or extremely hazardous, so first aid 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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### Section 5: Fire and Explosion Data

**Flammability of the Product:** Non-flammable

**Auto-ignition Temperature:** Not applicable.

**Flash Points:** Not applicable.


**Flammable Limits:** Not applicable.

**Products of Combustion:**  
Products of combustion are not available since material is non-flammable. However, products of decomposition include fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas. Reacts with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

**Fire Hazards in Presence of Various Substances:** Combustible materials

**Explosion Hazards in Presence of Various Substances:**

**MSDS of Sulphuric Acid**



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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.

(Refer Slide Time: 28:48)

The slide displays the Material Safety Data Sheet (MSDS) for Sulphuric Acid. The title "MSDS of Sulphuric Acid" is prominently displayed in green. The slide is divided into several sections, with handwritten red arrows pointing to specific areas of concern:

- Risks of explosion of the product in presence of mechanical impact:** Not available
- Risks of explosion of the product in presence of static discharge:** Not available
- Slightly explosive in presence of oxidizing materials:**
- Fire Fighting Media and Instructions:** Not applicable
- Special Remarks on Fire Hazards:**
  - Metal acetylides (Monocesium and Monosubidium), and carbides ignite with concentrated sulfuric acid
  - White Phosphorus + boiling Sulfuric acid or its vapor ignites on contact
  - May ignite other combustible materials
  - May cause fire when sulfuric acid is mixed with Cyclopentanediene, cyclopentanone oxime, nitroaryl amines, hexalthium dithiodic, phosphorus (III) oxide, and oxidizing agents such as chlorates, halogens, permanganates.
- Special Remarks on Explosion Hazards:**
  - Mixture of sulfuric acid and any of the following can explode: p-nitrotoluene, pentasilyl
  - er
  - trihydroxydianthracene, perchlorates, alcohols with strong hydrogen peroxide, ammonium
  - tetraphenylchromate, mercuric nitrate, potassium chlorate, potassium permanganate with potassium chloride,
  - carbides, nitro compounds, nitrates, carbides, phosphorus, sodates, picrates, fulminates, diniters, alcohols (when
  - heated)
  - Nitramide decomposes explosively on contact with concentrated sulfuric acid
  - 1,3,5-Trinitrobenzene/hydro-1,3,5-triazine + sulfuric acid causes explosive decomposition
- Section 6: Accidental Release Measures**
- Small Spill:**
  - Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary, Neutralize the residue with a dilute solution of sodium carbonate
- Large Spill:**
  - Corrosive liquid. Poisonous liquid
  - Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas, if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities

The slide also features a small inset image of a person in a laboratory setting and a footer with the NPTEL logo and "NPTEL ONLINE CERTIFICATION COURSE" text.

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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### Section 7: Handling and Storage


**Precautions:**  
Keep locked up. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.  
May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.



**Storage:**  
Hygroscopic. Reacts violently with water. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

### Section 8: Exposure Controls/Personal Protection

**Engineering Controls:**  
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

## MSDS of Sulphuric Acid



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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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**Personal Protection:**  
Face shield. Full suit. Vapor respirator. Be sure to use an approved certified respirator or equivalent. Gloves. Boots.

**Personal Protection in Case of a Large Spill:**  
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient, consult a specialist BEFORE handling this product.

**Exposure Limits:**  
TWA: 5 STEL: 3 (mg/m<sup>3</sup>) [Australia] Inhalation  
TWA: 1 (mg/m<sup>3</sup>) from OSHA (PEL) [United States] Inhalation  
TWA: 5 STEL: 3 (mg/m<sup>3</sup>) from ACGIH (TLV) [United States] [1999] Inhalation  
TWA: 1 (mg/m<sup>3</sup>) from RIVM [United States] Inhalation  
TWA: 1 (mg/m<sup>3</sup>) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

### Section 9: Physical and Chemical Properties

**Physical state and appearance:** Liquid (Thick oily liquid)

**Odor:** Odorless, but has a choking odor when hot

**Taste:** Marked acid taste (Strong)

**Molecular Weight:** 98.08 g/mole

**Color:** Colorless

**pH (1% solution/water):** Acidic

**Boiling Point:**  
270°C (518°F) - 340 deg. C  
Decomposes at 340 deg. C

**Melting Point:** -35°C (-31°F) to 10-36 deg. C (93% to 100% purity)

**Critical Temperature:** Not available

**Specific Gravity:** 1.84 (Water = 1)

**Vapor Pressure:** Not available

**Vapor Density:** 3.4 (Air = 1)

**Volatility:** Not available

**Odor Threshold:** Not available


**Water/Oil Dist. Coeff:** Not available



**Ionicity (in Water):** Not available

**Dispersion Properties:** See solubility in water

**Solubility:**  
Easily soluble in cold water.  
Soluble in water with liberation of much heat.  
Soluble in ethyl alcohol.

## MSDS of Sulphuric Acid



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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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[illegible]

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 nature, so a strong oxidizer. So this reacts violently with water, alcohol especially when water is added. So you need to take due care. So, and sometimes the special remarks they have given for the corrosivity.

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**Toxicity to Animals:**  
**WARNING:** The LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4 HOUR EXPOSURE.  
 Acute oral toxicity (LD50) 2140 mg/kg [Rat]  
 Acute toxicity of the vapor (LC50) 420 mg/m3 2 hours [Mouse]

**Chronic Effects on Humans:**  
**CARCINOGENIC EFFECTS:** Classified 1 (Proven for human) by IARC, + Proven by OSHA. Classified A2 (Suspected for human) by ACGIH  
 May cause damage to the following organs: kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth

**Other Toxic Effects on Humans:**  
 Extremely hazardous in case of inhalation (lung corrosion).  
 Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion.

**Special Remarks on Toxicity to Animals:** Not available

**Special Remarks on Chronic Effects on Humans:**  
 Mutagenicity: Cytogenetic Analysis: Hamster, ovary = 4mmol/L.  
 Reproductive effects: May cause adverse reproductive effects based on animal data: Developmental abnormalities (miscaribabital) in rabbits, at a dose of 20 mg/kg for 7 hrs (RTECS)  
 Teratogenicity: neither embryotoxic, fetotoxic, nor teratogenic in mice or rabbits at inhaled doses producing some maternal toxicity

**Special Remarks on other Toxic Effects on Humans:**  
 Acute Potential Health Effects:  
 Skin: Causes severe skin irritation and burns. Continued contact can cause tissue necrosis.  
 Eye: Causes severe eye irritation and burns. May cause irreversible eye injury.  
 Ingestion: Harmful if swallowed. May cause permanent damage to the digestive tract. Causes gastrointestinal irritation. Burns may perforation of the stomach. GI bleeding, edema of the glottis, necrosis and scarring, and severe circulatory collapse (similar to acute inhalation). It may also cause systemic toxicity with acidosis.  
 Inhalation: May cause severe irritation of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath, and delayed lung edema. Causes chemical burns to the respiratory tract. Inhalation may also as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Causes convulsive actions on mucous membranes. May affect cardiovascular system (hypotension, depressed cardiac output, bradycardia). Circulatory collapse with clammy skin, weak and rapid pulse, shallow respiration, and scanty urine may follow. The immediate cause of death. May also affect fertilization in both and supporting structures - enson, discoloration)

Chronic: Potential Health Effects:  
 Inhalation: Prolonged or repeated inhalation may affect behavior (muscle contraction or spasticity), urinary system (kidney damage), and cardiovascular system, heart (ischemic heart lesions), and respiratory system (pulmonary edema, lung damage), teeth (dental discoloration, erosion)  
 Skin: Prolonged or repeated skin contact may cause dermatitis, an allergic skin reaction

## MSDS of Sulphuric Acid

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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  $\text{H}_2\text{SO}_4$ .

(Refer Slide Time: 31:03)

**Section 12: Ecological Information**

**Ecotoxicity:** Ecotoxicity in water (LC50): 49 mg/l 48 hours [bluegill/sunfish]

**BOD5 and COD:** Not available.

**Products of Biodegradation:**  
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The products of degradation are less toxic than the product itself

**Special Remarks on the Products of Biodegradation:** Not available.

**Section 13: Disposal Considerations**

**MSDS of Sulphuric Acid**

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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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**Waste Disposal:**  
Sulfuric acid may be placed in sealed container or absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized. Be sure to consult with local or regional authorities (waste regulators) prior to any disposal. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

**Section 14: Transport Information**

**DOT Classification:** Class 8: Corrosive material

**Identification:** Sulfuric acid UNNA 1830 PG. II

**Special Provisions for Transport:** Not available

**Section 15: Other Regulatory Information**

**Federal and State Regulations:**  
Illinois toxic substances disclosure to employee act: Sulfuric acid  
New York release reporting list: Sulfuric acid  
Rhode Island RTK hazardous substances: Sulfuric acid  
Pennsylvania RTK: Sulfuric acid  
Minnesota: Sulfuric acid  
Massachusetts RTK: Sulfuric acid  
New Jersey: Sulfuric acid  
California Director's List of Hazardous Substances (8 CCR 339): Sulfuric acid  
Tennessee RTK: Sulfuric acid  
TSCA 8(b) inventory: Sulfuric acid  
SARA 302/304/311/312 extremely hazardous substances: Sulfuric acid  
SARA 313 toxic chemical notification and release reporting: Sulfuric acid  
CERCLA: Hazardous substances: Sulfuric acid 1000 lbs (453.6 kg)

**MSDS of Sulphuric Acid**

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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.

(Refer Slide Time: 31:44)

The slide displays the MSDS for Sulphuric Acid. On the left, under 'Other Regulations', it lists OSHA Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200) and EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances. Under 'Other Classifications', it lists WHMIS (Canada) CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC) and CLASS E: Corrosive liquid. Under 'DSCL (EEC)', it lists R35: Causes severe burns, S2: Keep out of the reach of children, S26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice, S30: Never add water to this product, and S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Under 'HMIS (U.S.A.)', it lists Health Hazard: 3, Fire Hazard: 0, and Reactivity: 2. Red arrows point to these hazard values. On the right, the title 'MSDS of Sulphuric Acid' is displayed in green. A small video inset shows a presenter in a lab coat. The bottom of the slide features the IIT ROORKEE and NPTEL ONLINE CERTIFICATION COURSE logos, along with the page number 41.

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.

(Refer Slide Time: 32:10)

**Personal Protection:**  
National Fire Protection Association (U.S.A.):  
Health: 3  
Flammability: 0  
Reactivity: 2  
Specific hazard:  
Protective Equipment:  
Gloves  
Full suit  
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate  
Face shield

**MSDS of Sulphuric Acid**

**Section 16: Other Information**

**References:**  
Material safety data sheet emitted by la Commission de la Santé et de la Sécurité du Travail du Québec  
The Sigma Aldrich Library of Chemical Safety Data, Edition II  
Hawley, G.G. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinhold, 1987

**Other Special Considerations:** Not available

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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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**MSDS Information**

**MSDSs are available from**

1. The chemical manufacturer
2. A commercial source
3. A private library developed by a chemical plant

**A Material Safety Data Sheet (MSDS) is designed to provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance.**

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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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**MSDS Information**

MSDS's include information such as physical data , toxicity, health effects, first aid, reactivity, storage, disposal, Protective equipments, and spill/leak procedures. These are of particular use if a spill or other accident occurs.

**MSDS's are meant for:**

- ✓ Employees who may be occupationally exposed to a hazard at work.
- ✓ Employers who need to know the proper methods for storage etc.
- ✓ Emergency responders such as fire fighters, hazardous material crews, emergency medical and emergency room personnel.



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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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**MSDS Information**

**MSDS's are not meant for consumers.**  
An MSDS reflects the hazards of working with the material in an occupational fashion.

**For example,** an MSDS for paint is not highly pertinent to someone who uses a can of paint once a year, but is extremely important to someone who does this in a confined space 40 hours a week.




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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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**MSDS Information**

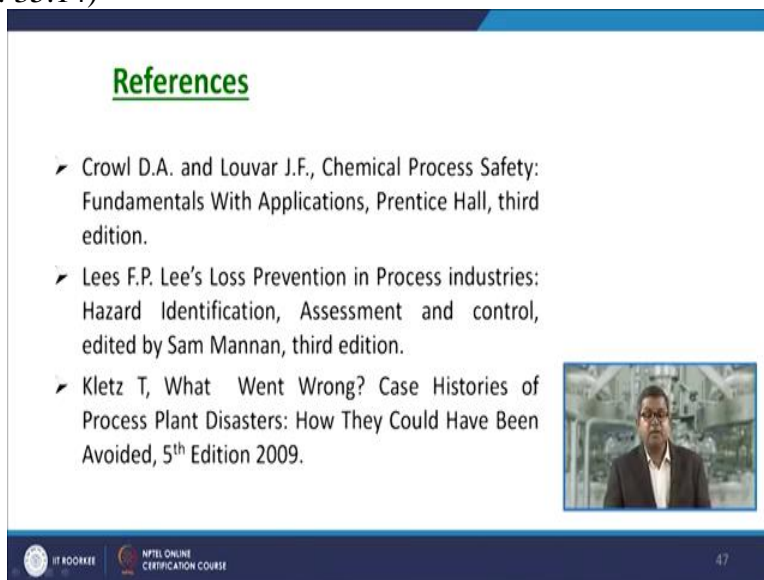
- ❖ The safety professional must interpret the physical and toxicological properties to determine the hazards associated with a chemical.
- ❖ These properties are also used to develop a strategy for the proper control and handling of these chemicals.



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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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**References**

- Crowl D.A. and Louvar J.F., Chemical Process Safety: Fundamentals With Applications, Prentice Hall, third edition.
- Lees F.P. Lee's Loss Prevention in Process industries: Hazard Identification, Assessment and control, edited by Sam Mannan, third edition.
- Kletz T, What Went Wrong? Case Histories of Process Plant Disasters: How They Could Have Been Avoided, 5<sup>th</sup> Edition 2009.

The slide features a small video inset on the right side showing a man in a suit and glasses speaking. The bottom of the slide has a dark blue footer with the IIT Bombay logo, the text 'IIT BOMBAY', 'NPTEL ONLINE CERTIFICATION COURSE', and the page number '47'.

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.