INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NPTEL
NPTEL ONLINE CERTIFICATION COURSE

Refrigeration and Air-conditioning

Lecture-38
Indoor Environmental Health - 1

with
Prof. Ravi Kumar
Department of Mechanical and Industrial Engineering
Indian Initiation of technology, Rookee

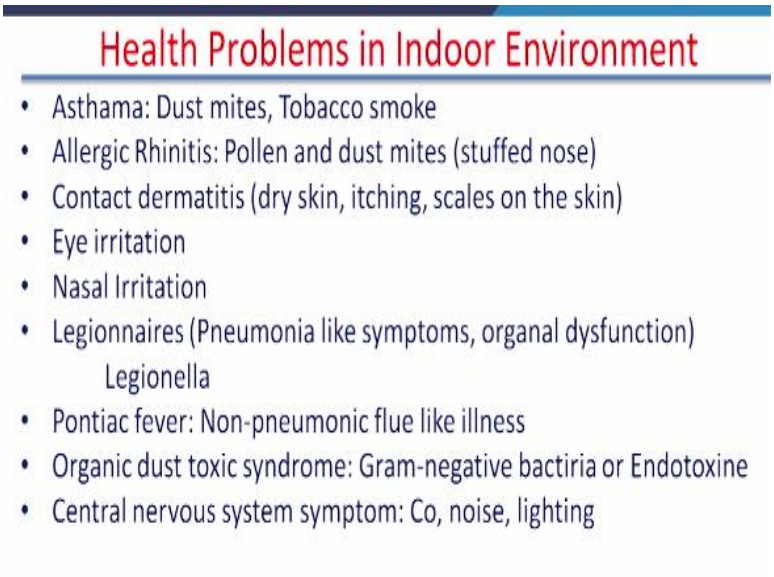
Hello I welcome you all in this course on refrigeration and air conditioning, today we will discuss indoor environment health in today's lecture will cover health problems in indoor environment health environment indoor environmental.

(Refer Slide Time: 00:41)

Airborne contaminants and gases contaminants in indoor environment. So indoor environment health indoor environment health it covers those aspect of individuals health which are affected by the indoor environment, so it is more concerned about the health of an individual if the indoor

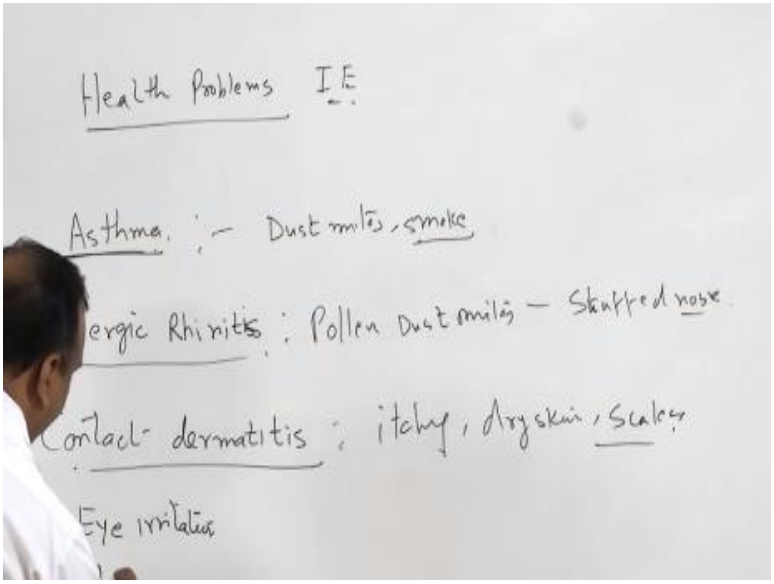
environment is not healthy or is sick then the definitely the occupants are also liable to fall sick, now health problems we should understand health problems in indoor environment.

(Refer Slide Time: 01:35)



Health problems in indoor environment, the health problems in indoor environment with the most common indoor environment health problem is asthma.

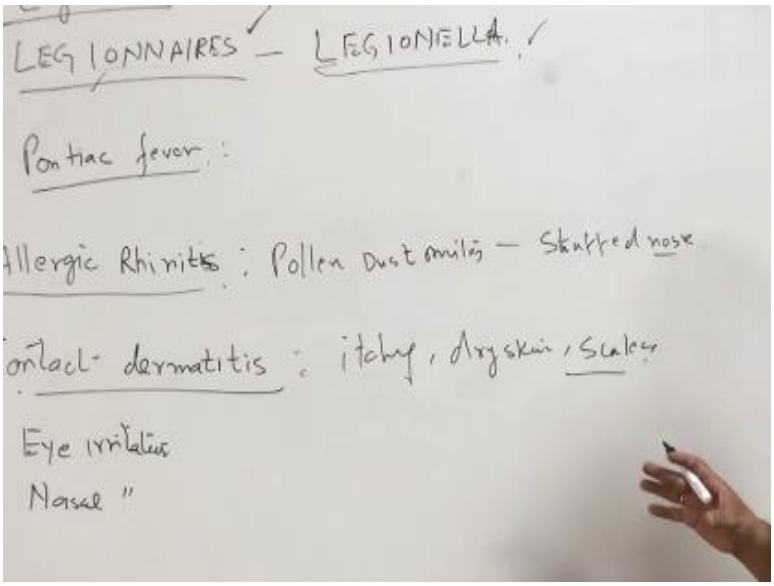
(Refer Slide Time: 01:54)



Asthma it is normally it is due to dust, mite and smoke, tobacco smoke so asthma is one of the problem which comes in the control environment that is another is allergic energy creditors in this is also by pollen and dust mite, okay. So in this in this disease there is a stuffed nose you must have observed that when you are sitting sometimes when you are sitting in the air conditioning.

And where mind you have the stuff is no nose when you go out things become okay, now third one is contact dermatitis this is due to in this disease there is a I mean dry skin and hitching dry skin and scale scales on the skin are formed, so this type of disease also may take place if the indoor environment is not healthy in addition to this eye irritation necessary eye and nestled in irritation.

(Refer Slide Time: 03:50)



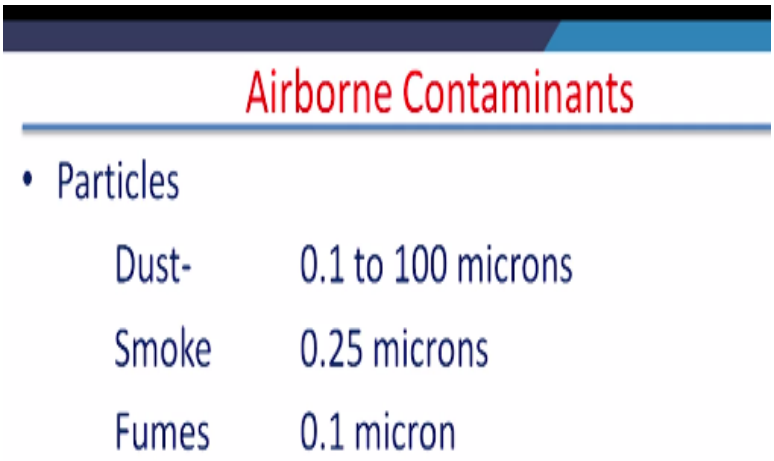
Further we can take here then the disease which is known as Legion nears, this spread through bacteria and it has pneumonia like symptoms this is a very I mean serious deadly type of disease and it has symptoms like pneumonia and fever Oregano dysfunction can also takes place and this is due to the bacteria this bacteria grows in the fresh waters, so the favorable ground for this bacteria is condensate water in the air conditioner.

Or in the cooling tower, especially the centralized cooling system you will find that there are number of cooling towers which are used for the purpose of cooling of cooling water in a condenser so they are also this bacteria can turn up and infection with this bacteria causes this disease and in this disease there is a high fever and organelle dysfunction can also take place, now in addition to this there is a Pontiac fever also.

Pontiac fever it is flu-like illness so the environment you are sitting if you feel that you have you have been infected with the flu so these are the diseases they are some of the diseases not all the diseases there are some of the diseases which you may catch up when you are sitting in control environment so you as I mean essay as a person you should know all about these diseases because they are coming from the control environment.

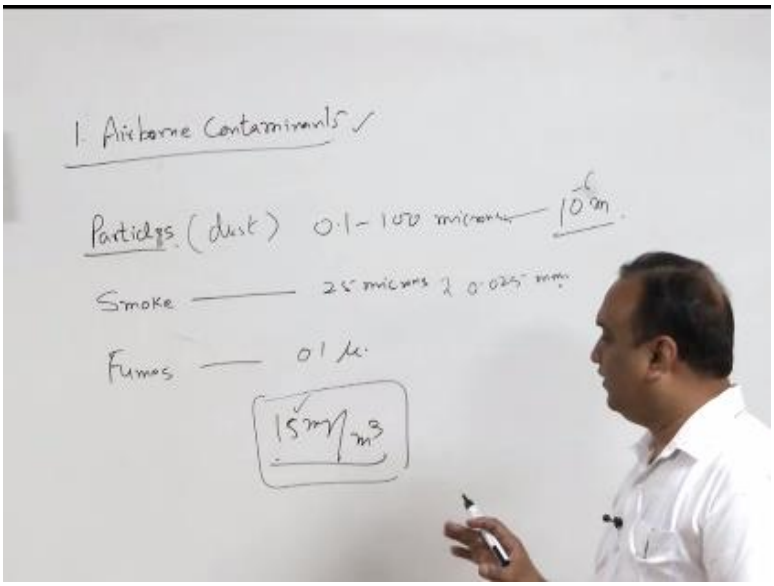
Sometimes what happens we catch up some disease but the source of disease not do to us so for these diseases the control environment can be one of the source. Now their number of contaminants in the control environment which affect the environment health.

(Refer Slide Time: 06:03)



And number one is airborne contaminants.

(Refer Slide Time: 06:08)

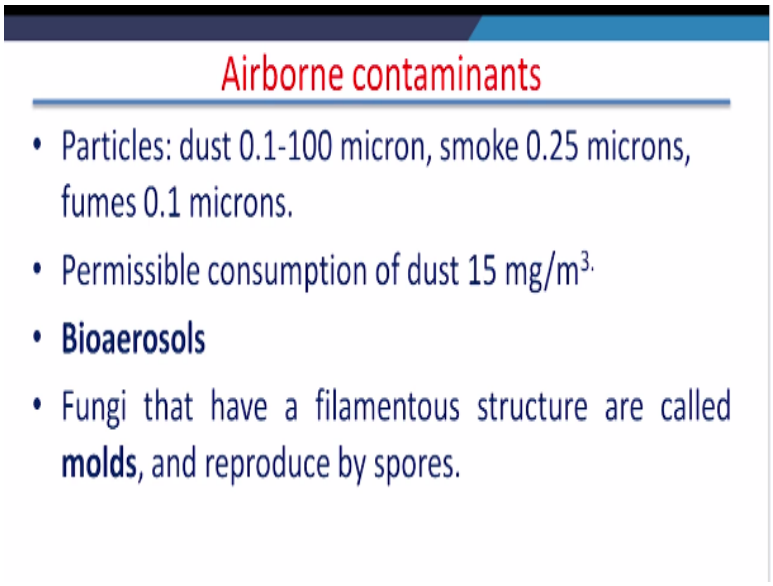


Airborne contaminants in airborne contaminates which are spread through the air they are particles and particles of dust normally they are of dust particles ranging from 0.1 to 100 microns, smoke particles spoke particle size is smoke particles particle size is approximately 25 microns, micron is 10^{-6} meter and fumes, fumes the size of the fumes is approximately 1.1 micron.

Not dust is major constituent of end or in airborne contaminants and the maximum per serviceable amount of dust which one can take in with the breathing is approximately 15 mg per meter cube, so this much amount of dust in the air is permissible if actually air should be dust free but it is if you want to have dust free air a lot of arrangements have to be made then you have to go for a cleaner and filters have to be provided.

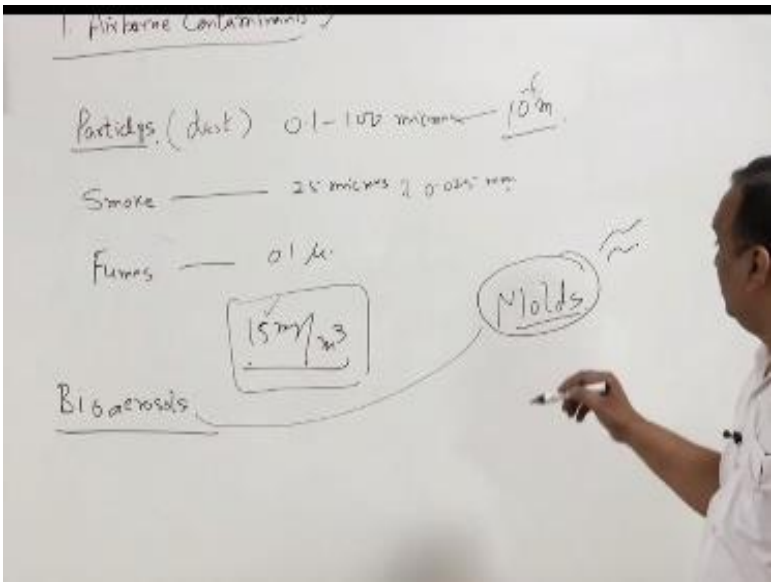
But if the presence of dust is approximately 50 is less than 50 milligrams mille grams per meter cube of air it is accepted for normal air condition not the special type of control environment but normal air conditioning it is acceptable.

(Refer Slide Time: 08:01)



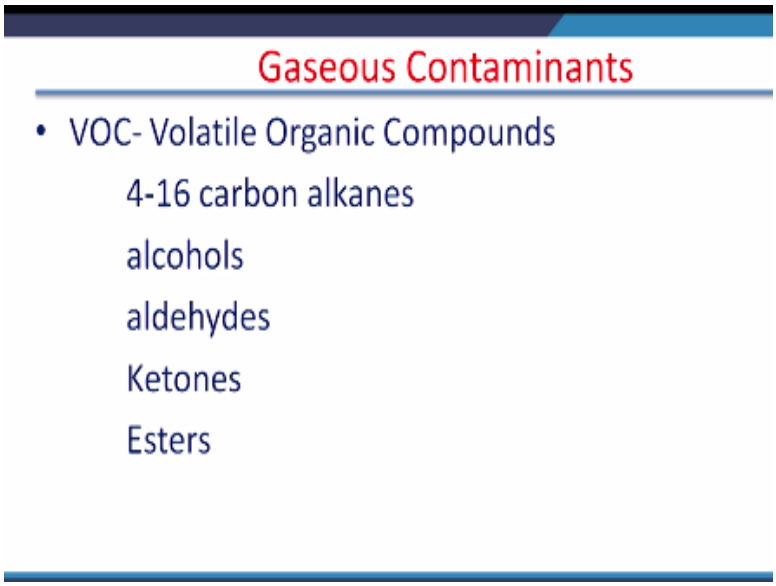
Bio-aerosol are also there.

(Refer Slide Time: 08:14)



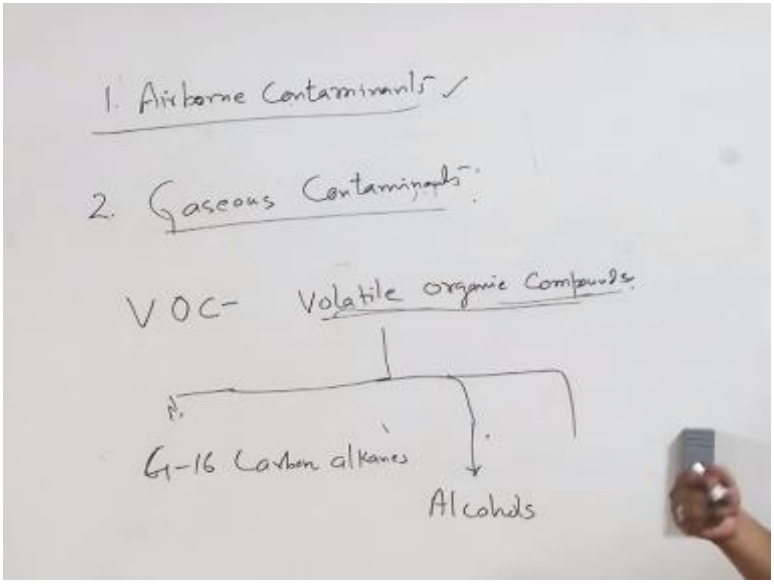
In this bio-aerosol comes the bolts mold is a major problem in air conditioned system it is sort of fungus which has filamentous structure and it develops in the confined space air conditioning space you must have also seen in those system which are centrally air-conditioned and they are air-conditioned for a long time along the wall or in many of the places or inside the duct also the mold develops.

(Refer Slide Time: 08:56)



So this is a very common problem in a air conditioning system so these airborne particles they consist of bacteria, fungal, protozoa, algae and combination of these, now after airborne contaminants there are gases contaminants.

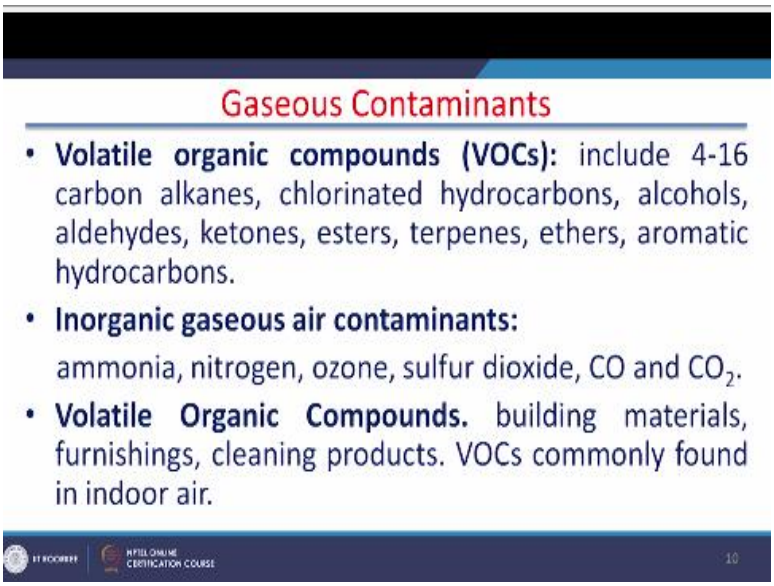
(Refer Slide Time: 09:06)



Which affect the indoor environment health gases contaminates, now gases contaminants are mainly VOC, this is volatile, organic, compounds now volatile organic compounds are very harmful to the human health right so in any building especially where volatile organic source of ever like organic compound is that they is there, so they have to be removed they make the airsick.

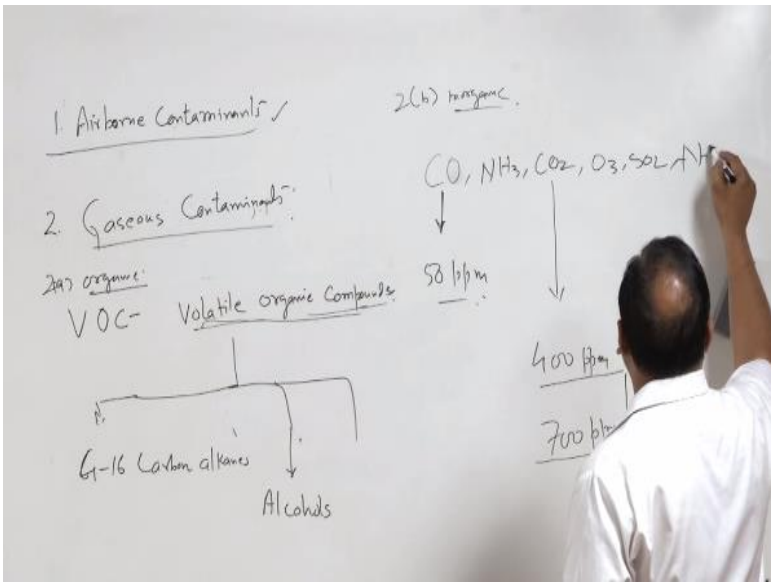
And number of what I cut down for example for 4 - 16 carbon, alkenes different type of argon alkynes, alcohols then alcohol, aldehydes, ketones, Easter so they are very many chemical or organic compounds and these were at I have compounds their vapors where they are mixed with the room vapor it makes it affects the quality of whip air which is being circulated in the room.

(Refer Slide Time: 10:46)



Now third one is Gases air contaminant the second one is gas inorganic.

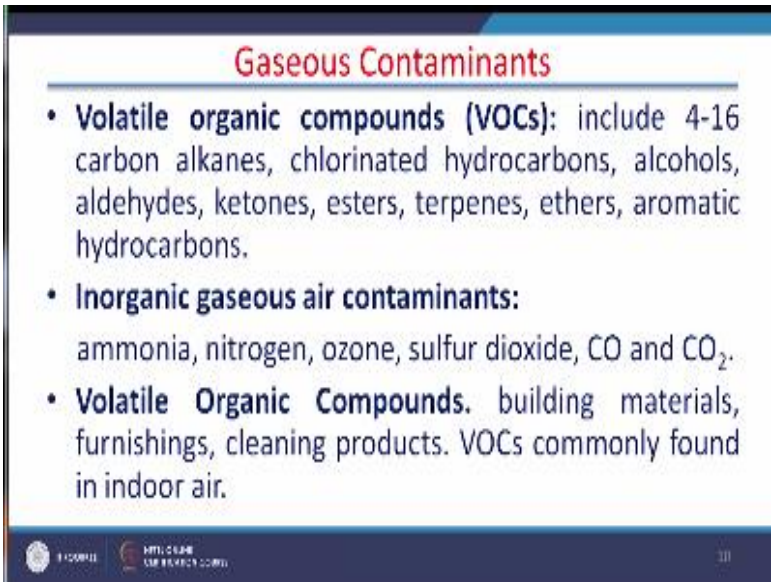
(Refer Slide Time: 10:53)



Now the gases this is organic to a these are organic and some are inorganic gases compounds, so 2(b) inorganic, so organic gases compounds they volatile organic compounds that is in-organic the first and foremost is carbon monoxide, ammonia, carbon dioxide, ozone, sulfur dioxide and many more the carbon monoxide which is I mean the which is odorless and colorless gas if the consolidation of permissible conduct concentration of carbon monoxide is 50ppm parts per million.

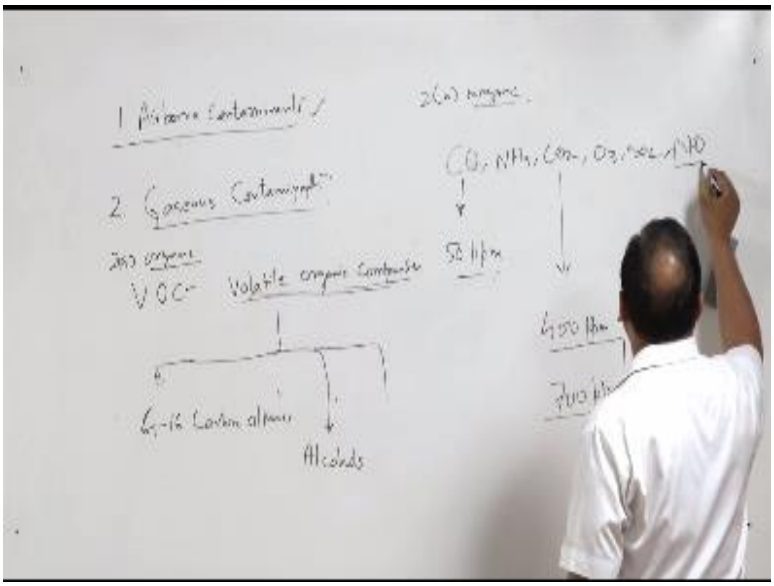
So carbon dioxide in the get in the air should not be more than 50 ppm carbon dioxide can go up to 400 to 500 ppm 400 ppm parts per million and it can go up to 700 also outside here nowadays in the metropolitan cities outside air is quite polluted so it can go but in any case it should not exceed 1000ppm a 1000ppm then it will make the it will affect the health of indoor environment and it will make the air sick inside the room.

(Refer Slide Time: 12:10)



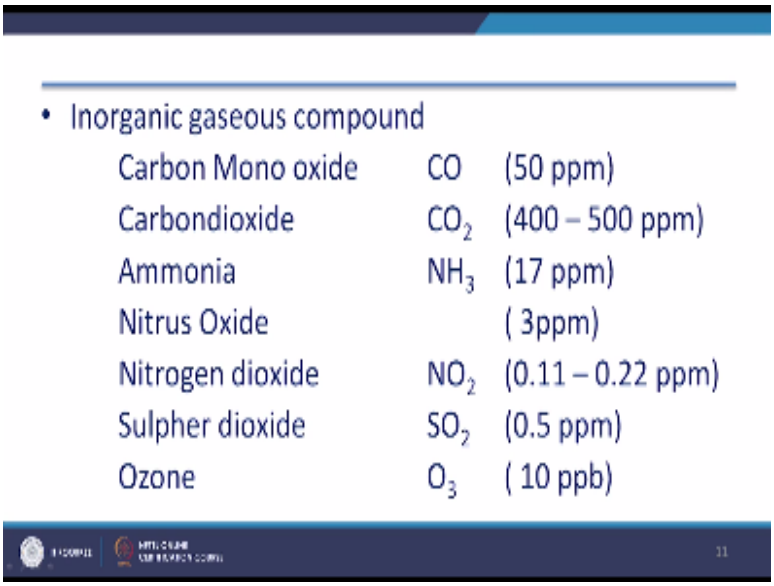
Now nitrous-oxide.

(Refer Slide Time: 12:15)



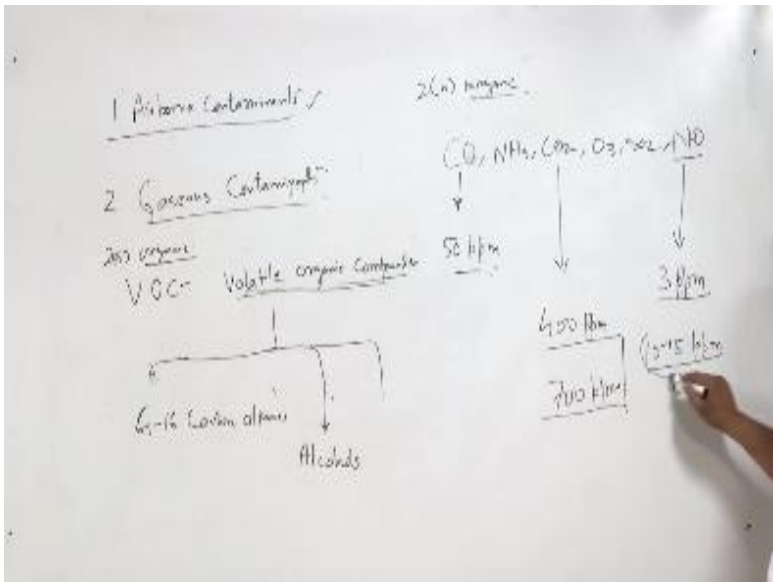
There is 1 aromatic compound is nitrous oxide.

(Refer Slide Time: 12:20)



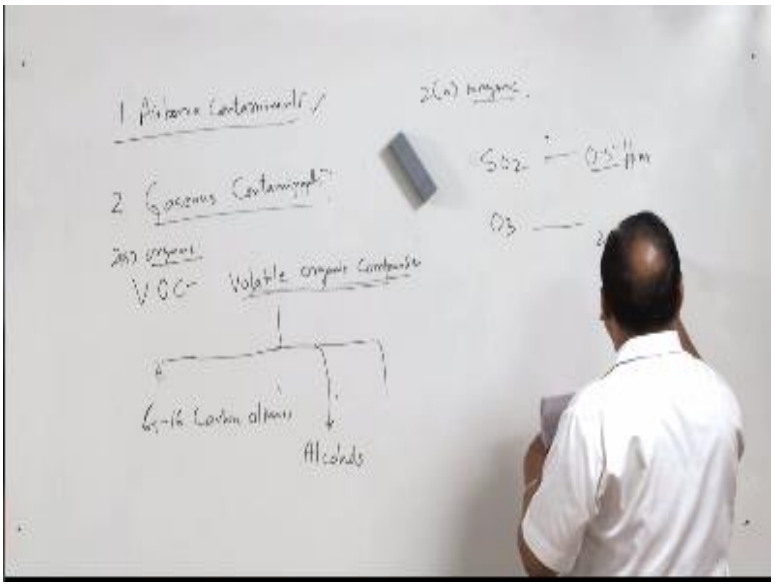
So nitrous oxide is also I mean if there is a 3ppm of nitrous oxide then it is equal to the exposure of 10 to 15ppm carbon monoxide.

(Refer Slide Time: 12:32)



So it is more fertile than carbon monoxide every it is I mean you can say 15 time it is only ppm is permitted for carbon monoxide it is equal into 10 to 15ppm of carbon monoxide nitrogen dioxide is also is one of the organic inorganic air gases contaminate that is nitrogen dioxide and nitrogen dioxide so I showed it is between 0.112 0.22 ppm.

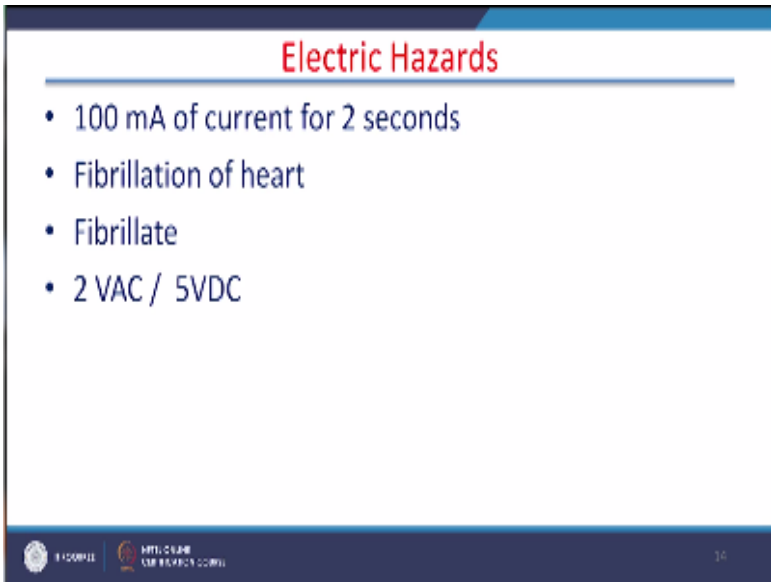
(Refer Slide Time: 13:20)



It is not soluble in water so nitrogen oxide when it is inhaled it is not absorbed in air pipe it is not absorbed by the walls of air pipe it goes deep into the Lungs once and it has delayed respiratory response so suppose you inhale the nitrogen dioxide the respiratory response will be delayed for this because it is not absorbed by any part of this either for air pipe or the lungs but if it is settled in the lungs then it will show the symptoms of delete respiratory system response now an other gas there is sulfur dioxide and ozone sulfur dioxide is 0.5 not more than that ppm this is permissible for ozone for ozone it is very interesting that it is 20 parts per billion you should not exceed.

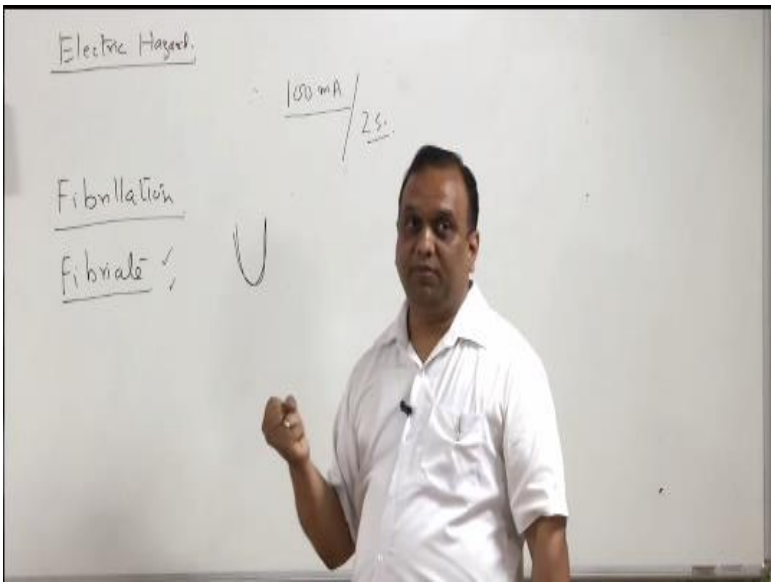
So zone is also I mean very dangerous guess it is 20 ppb which makes it fatal that is why it should be below 10ppb so these are the certain chemicals which creates health problem or which pollute the indoor environment now in addition to this now these airborne gases particles or gases particles.

(Refer Slide Time: 15:00)



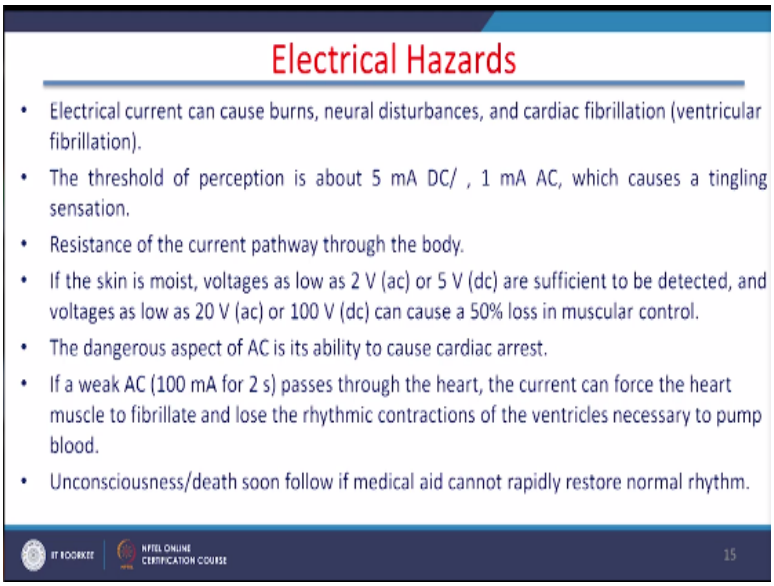
Electric hazard or also their electric hazard this has to be taken care of in the building.

(Refer Slide Time: 15:20)



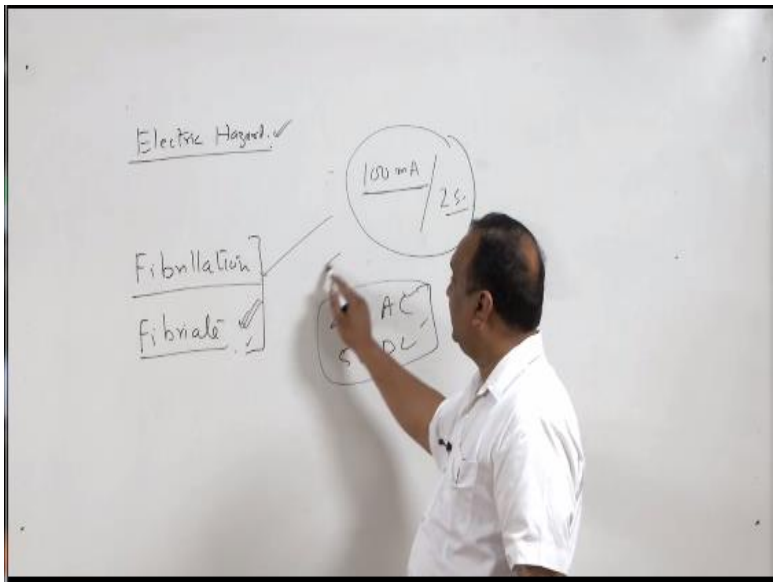
If 100 milliampere this is the interesting figure if 100 milliamperes of current is passed through heart for two seconds in that case fibrillation of the heart will take decreases or heart will fibrillation means the muscles will strength with each other and the heartbeat and pulse they will go out of rhythm and this happens with the ventricle of the heart where integral is a lower part of the hurt which pumps the blood in the in the body. So when the pulse and in the heartbeat they go out of rhythm the pumping problem arises.

(Refer Slide Time: 16:12)



And that is a very serious situation and this can be fatal also now second thing is the major part of the thermal resistance because our body fluid is a saline fluid so major part of resistance come from the our skin of an individual.

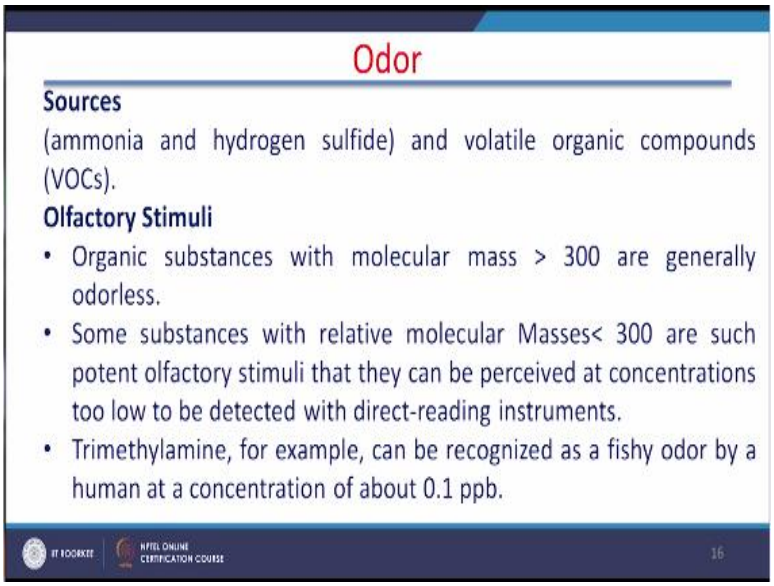
(Refer Slide Time: 16:33)



So if skin is wet right it is conductivity increases so care has to be taken in a building the soul in a confined space not only air but electric fitting also they should be properly insulated otherwise this may cause a serious problem so we do not require very high voltage a very high current to be fatal even this much of current is passed through the body I have been from top to bottom then this can cause serious accidents when your skin is low even the voltage of the order of two world DC or sorry 2 v AC and 5 v DC can be detected from your skin if the skin is wet.

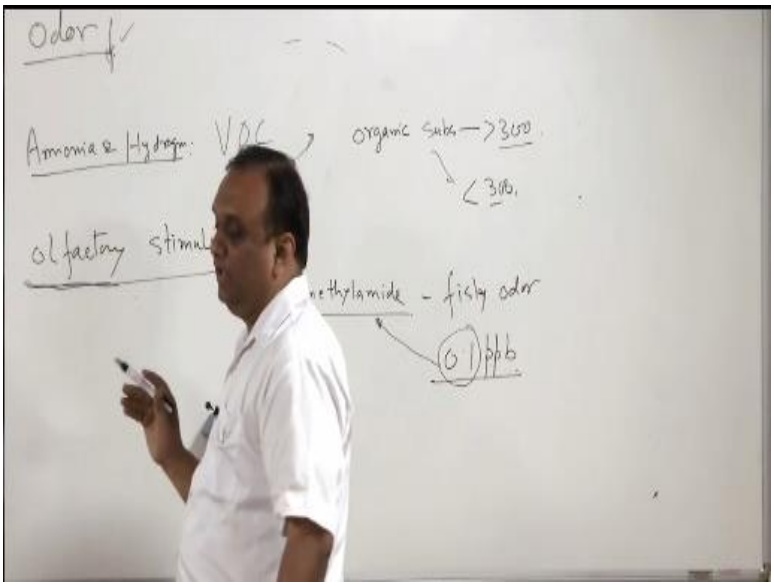
So in this case so if this happens if the hard fibriate proper medical aid is required to be given to the patient becomes sometimes or subconscious oh sorry unconscious and immediate medical help is required by the patient.

(Refer Slide Time: 17:46)



Now indoor health environment or door is also one of the factors on or in the air now source of water in the air.

(Refer Slide Time: 17:58)

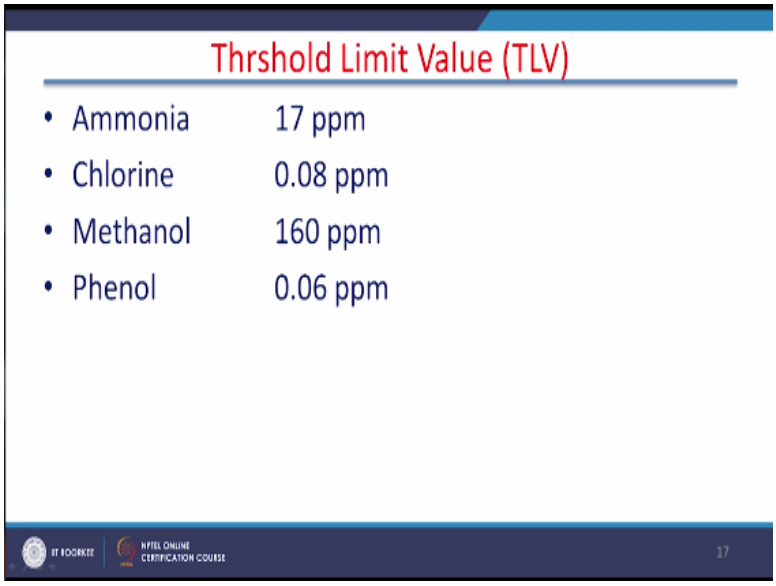


Sometimes you enter a closed environment the temperature is okay humility is okay air movement is okay level of fox everything is okay but if odor is there you do not feel comfortable now this order is due to ammonia and hydrogen sulfides normally and some of the VOCs volatile or make the bonds they add to the photo in the system so in any system minimum ventilation is required a minimum level of integration is required to remove the odor from the system so there are certain olfactory stimuli all factories stimuli means those substances which is stimulate which stimulate the sensing of odor by the nose.

So these is stimuli are any organic substance which is having molecular weight more than 300 it is normally odorless so if any organic substances present in the air which has molecular weight more than 300 it is odorless some of the substances having less than 300 are also odorless there is one thing there is a chemical trimethylamine and it is the feeling of fishier odor at the consolidation of 0.1ppb so parts per billion so for such a low consultation this chemical will give fishy odor.

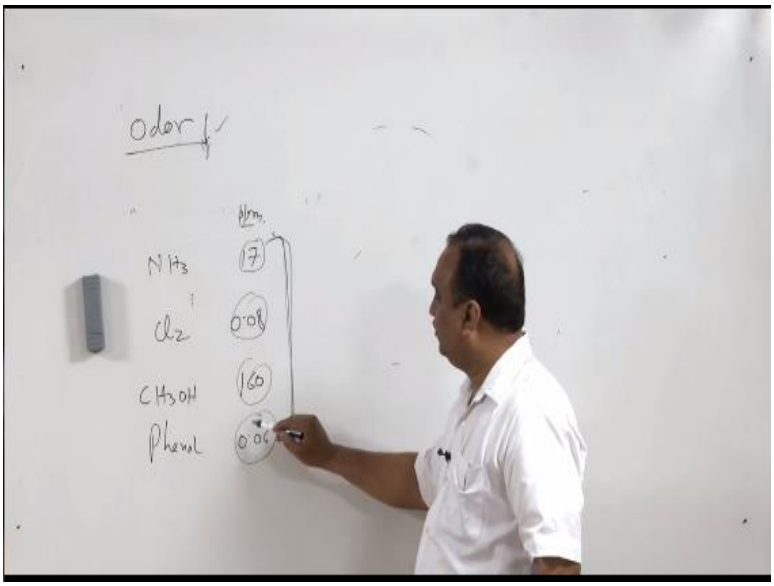
So like this there are number of chemicals right some of the chemicals it is possibility that some of such chemicals are mixed in the air but in any case in order to get over this problem of odor it is certainly enough ventilation has to be maintained in the building.

(Refer Slide Time: 20:09)



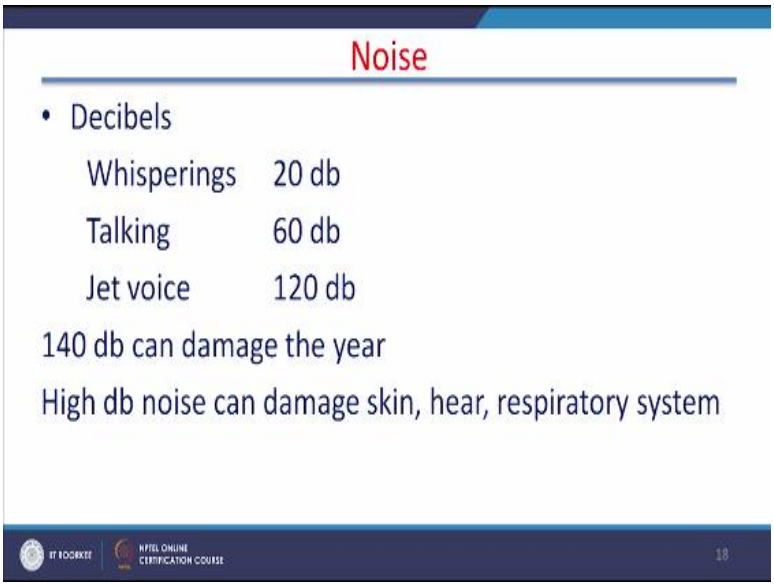
Threshold value for chemicals there is a regarding the odor there is a threshold value in ppm I will write to us for example ammonia.

(Refer Slide Time: 20:23)



Ammonia has to be less than 7 ppm in the am if it is more than 7 ppm you can feel the pungent smell of ammonia chlorine has to be 0.08 methanol ch3oh methanol has to be 160 ppm if it is more than 160 ppm you can feel the orphan all 0.06 likewise for all chemicals possible chemicals there is some threshold value so the presence of these chemicals in the atmosphere if it is less than these values you will not feel odor of these chemicals.

(Refer Slide Time: 21:13)



Another thing which disturbs the indoor environment health.

(Refer Slide Time: 21:17)

Is noise further if the temperature humidity air moment everything even know note is control if the noise is there in the in the occupancy in that case you will not feel comfortable the occupancy means some now it is expressed in noises expressed in terms of discipline right if somebody dispersed though I will give you some idea it is approximately 10 decibels I am just talking to this room the sound maybe odor of 60 decibels but the moment you reach 100 or 120 decibels it is a logarithmic scale.

So the moment It is double I mean 120 decibel it becomes unbearable it becomes a jet wise why noise of 140 decibel can damage the ear it can damage the ear high discipline noise can even damage your skin it can damage your heart it can damage your respiratory system affect the respiratory system so noise so be these odor of noise are not there in conditioning system but the noise level is low I mean as noise level it should not be more than 40 or 50 so there the occupants remain in a state of comfort this is all for today's lecture tomorrow again will take indoor environment health thank you very much.

Educational Technology Cell

Indian Institute of Technology Roorkee

Production for NPTEL

Ministry of Human Resource Development

Government of India

For Further Details Contact

Coordinator, Educational Technology Cell

Indian Institute of Technology Roorkee

Roorkee – 247667

E Mail: etcell@iitr.ernet.in, etcell.iitrke@gmail.com

Website: www.nptel.ac.in

Acknowledgement

Prof.Pradipt Banerji

Director, IIT Roorkee

Subject Expert & Script

Prof.Ravi Kumar

Dept of Mechanical and

Industrial Engineering

IIT Roorkee

Production Team

Neetesh Kumar

Jitender Kumar

Sourav

Camera

Sarath Koovery

Online Editing

Jithin.k

Video Editing

Pankaj Saini

Graphics

Binoy.V.P

NPTEL Coordinator

Prof.B.K.Gandhi

An Educational Technology Cell

IIT Roorkeee Production