Introduction to Research
Prof. Parthap Haridoss
Department of Metallurgical and Materials Engineering
Indian Institute of Technology, Madras

Lecture - 18
Safety in Laboratory

Hello. In the section, as part of a discussion on research activities, and specially a part of discussion on experimental research activities, we will look at safety in our research lab setting. So, now, safety is something that is a very board subject. It's a subject that is dealt with in great detail in many occupational working condition kind of situations. And so, what we are going to do here, is briefly just highlight specific aspects of safety associated with some of the common things that people encounter in their labs. If you want a much more elaborate discussion on safety, you really have to attend courses which are focused on safety. And some of the points that I am highlighting, in this very brief section here, are actually points that are elaborated upon in great detail in the many of the safety courses that are there. Many of them are there internationally, and you should certainly, I mean, take recourse to actually looking those courses to fully understand the range of concerns that exist with respect to safety.

Now, safety is there in industrial setting; it is also there in research lab setting. There is one major difference, I feel, that exists between industrial setting and research lab setting. In the industrial setting, typically, the activities that each person carries out in the industry is actually well defined. And so, there is very little variability in that activity, little variations in that activity over a period of time. Therefore, the procedures that they follow, the safety equipment that they have, and the aspects of safety that they focus on are actually well defined for each individual. In a research lab setting, actually, quite the opposite is true. Most of the time we are trying to do new experiments. We are making new experimental set ups and we are trying out some new feature in our experiment and so on. Therefore, we are often pushing the boundaries in various different directions. And so, we have to be even more actively involved in figuring out the aspects of that experiment that require us to be more careful, and you know, where we have to put in more effort and ensure that the experiment is carried out safely. Now safety is important

for all the people who are present in lab, for yourself, and also for the equipment, and even for the experiments itself.

Now, I would also like to point out that, you know, safety is an aspect of culture. So, it is something that you have to build into you; it doesn't happen overnight; it's not something that, you know, it's just not just a matter following just a few procedures; it is being involved in the process of safety, and only then, you can actually, you know, make your work place a very safe work place.

Now, in a typical lab, some of the things that you would see in a typical lab, which require, you know, formal ways of, you know, addressing, so that you do in a safe manner are: first of all, in most labs you would see chemicals. So, chemicals is something that is very common in most labs; you will have, you know, acids; you are going to have bases; you are going to have, may be, powder samples; may be biological samples and so on; so, the variety of different samples which all are essentially chemicals. So, you could have a variety of chemicals which are present there in a lab. So, that is something which requires some level of formal attention for you to handle safely.

(Refer Slide Time: 03:19)

The other thing that is commonly present in a lab is electricity. I mean any lab you go to, at least to power the basic infrastructure that is there in the lab - it could be lights, it could be fans, it could be some kind of, you know, temperature control system, whatever it is or to even just power equipment that you use for your experiment, you are going to

need electricity. So, electricity is another thing that is commonly present in the labs. And it is one of the things that we most often tend to take for granted, because it is something we see on daily basis, but still actually there are very great many things that we have to be aware of with respect to electricity, to ensure that we handle it safely.

(Refer Slide Time: 03:55)

So, then, the third thing that is commonly present in labs is water. We always have, you know, some kind of a sink or a washbasin where you are going to, you know, clean may be glass utensils, may be your hands, few different things that you might do there. So, therefore, invariably, labs have some source of water, some arrangement for water in the lab. So, that's the third thing that is very common in the lab.

(Refer Slide Time: 04:19)

The fourth thing that is very common in the labs is the gas bottles. Of course it depends on what experiments you are running, but many experiments will often require a some kind of a controlled atmosphere. So, maybe you have a nitrogen bottle maybe you have argon bottle or maybe even an air bottle, but most important thing is the bottle is a pressurized unit. There is gas present inside it under high pressure. So, there is certain way in which it has to be handled. So it has to be handled safely. So, that's the other common thing that we see in labs.

And finally, the other thing that I would highlight at least from the perspective of what is commonly present in labs is a heat source. In almost all our labs, we have at least a hot plate, where we are heating our samples or maybe you have an oven where you, again, you know, bake some sample to remove moisture from it or something like that or you have furnaces. And Furnaces, you know, could range in temperature, going from room temperature to something like 1000 degree C, 1500 degree C. So those are very high temperatures and you need to be careful when you handle furnaces. There are also furnaces which are vertical, there are furnaces which are horizontal, there are box type furnaces, there are tube type furnaces; so lot of variety in the type of furnaces that you have there, but principally they bring into your work place a source of heat which could be controlled, which would be running at a very high temperature, and therefore, you need be careful when you handle that source of heat.

So, these are the major things that you would see in a lab. And in next several minutes, we will look at at least some of the major safety aspects associated with each of these activities that you may do in a lab sometime.

I will begin by discussing with you the general apparel that we wear in a lab. So, common things that are good to have and good to wear on a regular basis, which makes automatically build safety into many of the things that you do are first of all to wear a lab coat. So, the moment you come to a lab, you should have a lab coat and you should put it on. It is a simple thing that you put on which immediately adds some safety to you. So, many things that if you have, you know, a few drops spilling on you, they do not directly fall on you, they fall on your lab coat. So, that provides you some protection. And most of the things that I am going to show you today are things that are very cheap, very easy to buy, and therefore, they don't cost you much, but they greatly enhance the safety for you in your work place.

So, the first one as I said is your lab coat. You should definitely have one which you use on a regular basis.

The other most common thing that you should have in a lab is, you know, a set of gloves. These are nitrile gloves. I will show you other forms of gloves that are around. So, this is a standard thing that you can wear. Our first protection is our skin, and then, you know if you are handling samples, you are actually going to put, you know, samples in your hands, which would then fill pores of your fingers if you are not having a set of gloves. So, whatever it is, whether it is, you know, carbon sample or any other sample that you are using, you don't know what is the thing that is going to be toxic. As a matter of routine, so you may be handling something, and you do not, you may not be immediately always alert to exactly what is the level of toxicity of the things. So, it is best to have a pair of gloves on your hands when you are in the lab as you start operating various experiments. It also provides automatically provides you with some insulation. These are thin enough so that you can have enough of feel of what it is that you are handling. So, they do not get in the way of your experiment, but they provide you with a lot of protection. May be the only thing you have to be concerned about when you wear a pair of gloves is that some of them may or may not handle a particular solvent or particular form of liquid. So you should be aware of what is the capability of the glove and then use it accordingly.

The third most important thing, I won't even say third most important thing, it is the most important thing that is there, but the third one that I am going to talk about is safety glasses okay. As you can see, I am already wearing a pair of glasses okay; so a lot of people assume that once you wear a pair of glasses, you don't need to wear anything else. In fact, that is a very wrong notion. So, safety glasses are distinctly different from just a pair of normal glasses. So, normal glasses these have power, they have some power. So, basically, they have been designed for my eyesight and that is why I am wearing them, but the most important… there are two aspects of this glass which makes it inadequate as a safety device. The first is that it does not provide you complete coverage. As you see that the side of my eyes are open. This side is open, top is open, bottom is open. So, if I am doing any experiment, if something spills, there is fair chance that it can reach my eyes and that is something that we need to avoid. So, therefore, we have safety glasses which do a much better coverage of your eyes. So, that something I am going to show you.

So, one aspect that this glass is not good at is the coverage that it provides, but there is another aspect in which it is not sufficient as a safety device, and that is that this is not shatter proof. So, this is just glass. So, if something strikes it, depending on the velocity with which it strikes it the momentum it has, the glass can shatter. So, if the glass shatters, actually, it is even more dangerous for your eye, than simply some object hitting your eye, because that glass now has lot of glass pieces which can enter your eye. So, therefore, the two things that the eye safety equipment has to do is to cover your eye and also be reasonably shatter proof. So, here is an example of a safety glass. You can see that it is fairly well covered. You can see the sides are covered okay. This side is covered, this side is also covered. The top is covered and the bottom is covered. So, if I were to…and usually these are sized slightly large, so that you can wear them on top of your prescription glasses or your standard glasses - that spectacles that you may be using. So, they are specifically designed that way. So, I can comfortably wear this and it would cover my eye. It would also cover the glasses that I am using. So, it doesn't affect my eye sight. I can still see perfectly fine whatever it is that I wish to see, but it provides me with a lot of protection.

May be the only thing that may cause discomfort to you, but for which there are a lot of variety of glasses that you can look at is the fact that it actually may make it little hot for

you inside here. So, based on where you are working, if it's a humid environment you are working in, it may tend to become slightly uncomfortable for that reason, but the safety that it provides to you is indispensable. And in fact, this is necessary not just for working with chemicals, I highlighted the aspects of it that would help you in the case of a chemical spill, but really even if you are, you know, putting a nail on a wall, the common thing that happens is as you are nailing, hitting the nail on wall, the nail slips and it flies off. You hit it and it just flies off. And when it flies, you have no control on where it flies. It could easily strike the person's eye. So, many accidents happen where they are just striking a nail, and it just strikes the person's eye. And this a simple device which just cost a few hundred rupees or may be just a few dollars, if you buy it in some foreign location, that provides your eye with great level of safety. And these glasses are available in a variety of different styling. So, some of them actually have well defined and well directed porosity that ensures that some amount of, you know, cross flow of air is there without compromising the protection that it provides you from the perceptive of a spill.

So, these are some safety devices that are prevalent. I will show you some more.

Right we will now look at specific safety equipment and I will highlight some of those features of those equipment. I started by showing you the goggles that I was wearing. I just want to point out that we have a lot of variety in those goggles. So, this was the one that I was showing you, but there are several other versions which are similar, which may serve different purposes. So, this has some additional shielding in case you are seeing something that has a strong glare associated with it. And you also have something which is a shield; basically, a shield that covers your face, which would cover a big broader region of your face, which you can then use to do certain other types of experiments. So, these are a few different types of safety equipment that you can use, which would primarily protect your eyes, but would also cover a fair fraction of your face. So, this is some equipment; as I said a lot of variety is there. If you look for it, you will find several versions of these, which may be targeted and you know specified for a particular purpose. So, you should really look at it, and find it, and buy it.

Based on the experiments that you are doing, you may also need to protect yourself from dust. So, dust is something that again depends on the kind of sample you are using and it also depends on the specification of the sample. So, this is a simple dust mask which is a

surgical dust mask kind of thing that you can get, which I am pointing out here, and this is easily available in many, you know, medical stores or drug stores. Then, you can use them, but it depends on your experiments. For some particular purposes, it may be sufficient; it may be highly ineffective with specific types of samples. So, you need to be very careful whether this is adequate for you or not. So, you need to find out whether it is adequate, but if it is adequate, you should be in a position to use it. What I am now showing you is a much more elaborate mask which deals with dust. Here there are some filters in the front, which you can select what kind of a filter you want to use, and then, use it. It would completely cover your... If you put it like that, it would then completely cover your nose, and then, you would… whatever you breathe would then be filtered through this device. So, it is a much more elaborate and, you know, designed device to protect you from dust of any particular chemical that may be present as part of your experiment.

As part of safety associated with thermal things that we do in a lab, perhaps the most important thing is handling hot items, equipment that may be hot or samples that may be hot. Straight forward thermal capability gloves are there which can handle fair bit of heat and protect your hands from the heat. So, these are slightly large gloves, which if you wear are usually a little cumbersome to handle samples, but you have to get used to them if you are going to be holding tongs which are likely to be hot or some sample that you need to handle, some sample that is little hot, but these gloves are available, and this adds to the safety equipment in the lab. You should have a set of these gloves handy in your labs, so that you can use them as you would need that.

This is another pair of gloves which I wanted to show you. These are actually, specifically meant for handling and they are more resistant to acids. So, if you are working with acids, then these may be better gloves to have, so that you can handle them in a safe manner, because you don't want anything spilling on your hand, damaging your hand very badly, severely. So, these are simple safety devices to help you in that case okay. These are other form of gloves that are commonly available. This is also a pair of nitrile gloves, which are there. They are just simply different versions what I am currently wearing, different sizes, different thicknesses and so on are available. And they do provide you with fair bit of safety. So, as I mentioned, as I have just shown you, there are a set of gloves which handle, which provide safety for your hands, and then, there are

masks which provide safety for your nose, for your breathing process, and there are set of shields and goggles which provide protection for your eyes, in addition to the uniform that you wear, which then provides you with general protection.

So, we will now talk a little bit about gas bottle safety, and as I mentioned, the point here is that I am just highlighting some very important aspects of safety. And in all cases, there is a much more elaborate treatment of these topics. So, the point that we need to pay attention to, when we are dealing with the gas bottle, is that this is a structure inside which there is pressurized gas, and to access the gas, we do put a regulator on top of the gas bottle and this is the neck, so to speak. So, now, once you put the regulator, this is, the neck is in a delicate situation, meaning if the bottle were to fall, there is a great chance that the neck can break. If the neck breaks, the gas can come out in an uncontrolled manner, and then, it's a very dangerous situation. So, therefore, a very important thing to do when you are dealing with gas bottles is to ensure that the gas bottle is constrained, restrained such that it cannot fall down. So, a simple thing that is done is to put a chain like this, so that it is then attached to the wall; there should be a good securing system on the wall from which there is a chain that comes around, and then, goes around the gas bottle.

So, any time you walk in to a lab, if you see a gas bottle, you should see it restrained in this particular manner. It is also important to remember that is not sufficient that you simply have a chain that is around the gas bottle. You should make sure that the chain is roughly about two-thirds or above the… closer to maybe say three-fourths of the height of the bottle. So, that ensures that the bottle cannot be topple down. So, if you have the chain too low, then you have actually not served the safety purpose, because if it is too low, the bottle can still fall down. Only if it is reasonably high, the bottle will not fall down. So, a very important, a very simple thing that you can do when you are handling gas bottles, but makes a great difference to the safety in the process of handling gas bottle, is to make sure that you have this kind of a chain arrangement, which then, you know, holds the gases bottle securely. It doesn't allow the gas bottle to fall down. This is particularly important the moment you put a regulator on the gas bottle. You must never have a gas bottle in your experimental setup or in your lab, where you have put a regulator, where this neck is not covered, and you still don't have it constrained or restrained or secured.

So, you must have it properly setup this particular manner and that is a very important aspect of safety associated with gas bottles. Incidentally, the same safety would also hold when you are trying to, if you have to transport the gas bottle. Typically, to transport the gas bottle, there are trolleys. Those trolleys will have an identical arrangement in them. So that the gas bottle is loaded on to that trolley, and there will be a system which secures the gas bottle and prevents it from falling down, and that would be very similar to what you are seeing here. That would be some kind of chain that those goes around the gas bottle at an appropriate height and secures the gas bottles, so that it does not fall down.

So, this is a very simple thing that you can do, but greatly enhances the safety of your laboratory and your experiment and it is an absolute must; you should not have a gas bottle which is not secured in your lab.