Engineering Thermodynamics
Prof. S. R. Kale
Department of Mechanical Engineering
Indian Institute Technology, Delhi

Lecture - 03
Thermodynamic Concepts: Questions & Answers

So, there are any questions now. We have some time we will take questions first ok. So, first question here say, what is the difference between adiabatic and isentropic process. So, I will answer to the question right now.

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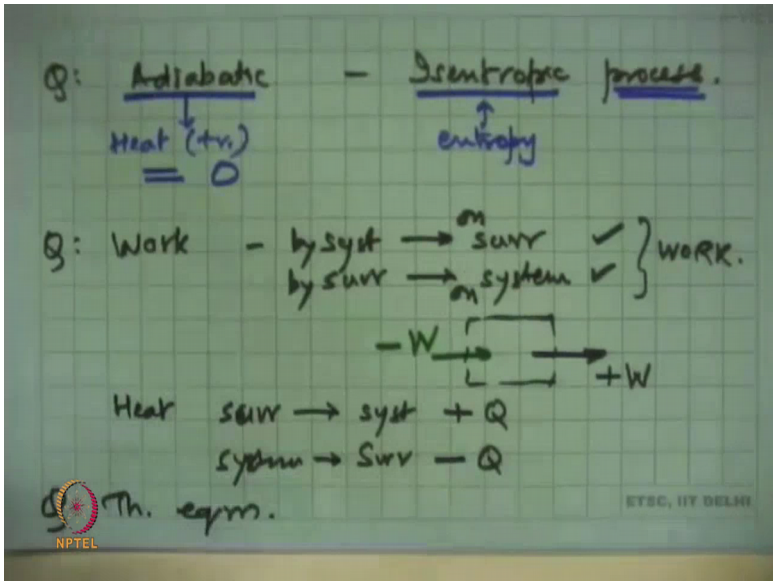

The question is adiabatic process, what is isentropic process. So, for that, we need to first learn what is a process. We have pick it up tomorrow to learn about isentropic process, we need to understand what is the property called entropy. This will come in the second module when we look at the second laws of thermodynamics.

Adiabatic we can talk about right now, it is basically that if a system undergoes a change which is a process and heat transfer from system to surroundings is 0. So that means, during that process the system does not exchange heat with the surrounding or vice versa that is an adiabatic process. We can think of that system has been enclosed in a ideal insulation even thermodynamic.

But we will come back to it say like tomorrow or may be day after tomorrow, we will look at what are processes and then we will look at all the other sub classification of processes. So, just wait on it, I will come back with this ok. There is another question here, thermodynamic work only possible from system to surroundings or surrounding to system or both.

So that question here, if thermodynamic work and when they call it work, is it possible only when system does work on surrounding or surroundings do work on system; both are. Work can be done by the system on the surroundings or by the surroundings on the system both classifies as work ok. I one more thing we can add here since question has come up.

If system does work on the surroundings; that means, there is work out of the system boundary. We give it a positive W. If the system is work upon by the surroundings; that means, say in the cylinder piston arrangement the piston was compressing it that we will call it as minus W. And in the same way, we will also say that heat comes heat is transferred from surroundings to system. This is plus Q from system to surroundings minus Q. So, work and heat can throw either way, there is no restriction on it. Symbols are this and there is sign convention is as I have just explained here.

Next question, please explain thermodynamic equilibrium. When it come to equilibrium in tomorrow's lecture so, just please wait ok. I will be cover it in full detail tomorrow. And then please explain continuum concept and the conditions under which it is valid ok. So, we have time ok.

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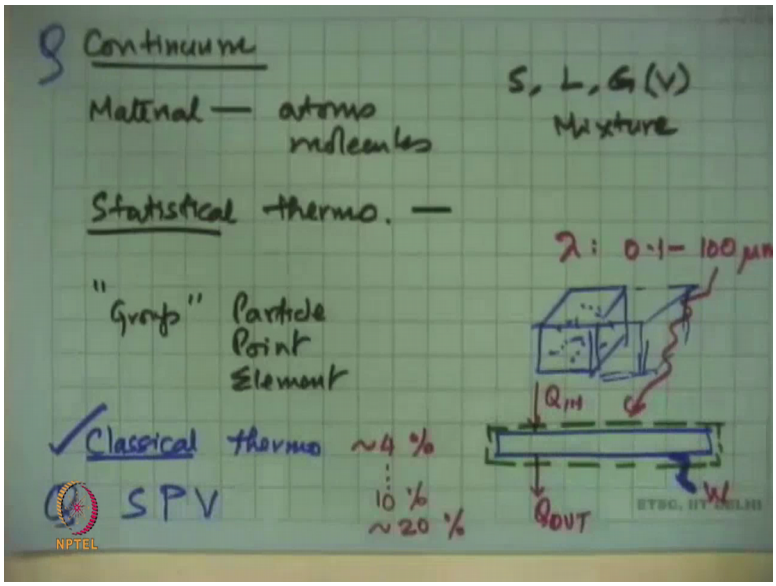

I will very quickly do this and tomorrows lecture we will continue from here. What is the continuum approach? We looked that at any material has atoms, molecules. It could be solid could be a liquid, there are gas or even we call it as vapour or it could be a mixture.

If we go and look at every atom and every molecule and ask what it is doing and why it is doing it, it takes as into that branch of thermodynamics which is called statistical thermodynamics. Statistical because they are too many molecules, too many atoms we cannot worry about each and every one of them. So, we take all those things together, go back to using statistical techniques and come out with some description of what the system is.

So, that is why it gets statistical thermodynamics. In this course, we do not do that. It is a very interesting and exciting subject by itself. We will not be going into this. What we do is that instead of looking at every atom or every molecule, we take what we may call group of molecules or we may call it a particle or some may call it a point, some may call it an element.

And its simplest depiction is that, we say that in the material whichever it may be over here, we will take a small volume and there got some size. I have not yet set what size it is or it is in driven, but we will say that all the atoms and molecules that are containing in this it will volume. I will not worry what each one of them is doing, but I will say that this whole thing is varying in some particular way ok.

So, this gets us to the approach which is called classical thermodynamics and that is what we will be doing in this course. So, we have moved away from individual particles and looked at what this is and then we can talk of how these elements interact with one other. We do not go too much in to that. Again in this course, but how they will all interact with together that takes us into the real world or continuum.

Come back to it later tomorrow again, I am just we have little time the questions put and I am just saying this; but we will elaborate this tomorrow.

Student: Hello, good morning sir. My name is Ridhil Varma and I am from Dhronacharya Vollege of Engineering, final year student. Sir, actually I and my team had made an electric vehicle. So, my question is like if I was planning to install solar energy to it. So, when I search to the market survey, the cost of the panels were quite high and the output was low. So, what can we do so that we can reduce on the cost and get the maximum output out of it? Thank you sir.

So this is a question about solar panel; solar photo vortex cells what it is called. So, if we have to look at the analysis of this, one say that this is the panel and quickly we will see that there is no mass inflow, there is no mass outflow there. They generate electricity in S P V depend on the band gap energy of that particular substance which means that it is only in a particular wave length that this material will absorb that energy from the solar spectrum.

So, what you are seeing here is that if this is the solar spectrum, which have got everything from 0.1 to 100 micro meters in wavelength. But the material can absorb energy only in a very small band may be 1 micron somewhere here or there. So, huge amount of the energy which is coming from the sun does not get converted into electricity and efficiencies also these panels will very very low. So, 4 percent, 3 percent, 2 percent a few years back and that is nothing much happened to increase their efficiency until the price of oil went to 150 dollars of barrel and climate change we can an issue and people say who are.

Let us now try to move it from oil. Let us do something to improve the efficiency of the solar cells. And gradually these number started going up, 10 percent is what you see in these days. And in the laboratory, there are all types of researchers, businesses and engineers all trying to develop materials hoping to get this. And in very few cases, they

have reached something of the order of 20, 30 percents of work, but that still remains very low output of these panels. There is nothing heat can do immediately we are restricted to buying what is there in the market.

So, when these high efficiency panels come up in the market until that only thing (Refer Time: 10:03), but otherwise this is a limitation of solar photo vortex cells. There is nothing we can do straight away on this, yeah.

Student: Hello good afternoon. The question that I have; it is a two part question. The first question is when can be expect automobiles run only on electricity and the second one is how will that change in the conception of coal and oil currently in the market.

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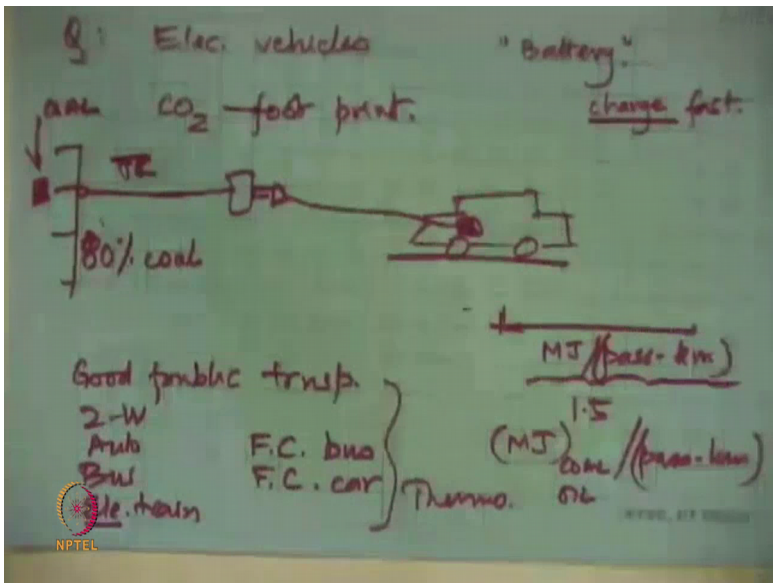

So, so this I have got two questions in there. One is about electric vehicles and the second is what is the overall balance of the electric CO 2 physical quantity, the carbon footprint of electric vehicles.

The main challenge in electric vehicles has been ability to storage electricity to store charge and that is where it is battery technology. That is most important and nothing will change unless new batteries come battery which can store more energy and more importantly which can charge and discharge you can always be fast, but fast charging is a major issue.

This is again many industries and research groups are working on this. In India, we have very very little work going on this. This is not mechanical engineering, this is not electrical engineering, this is not chemical engineering. Battery is everything on one goal is lot of materials and (Refer Time: 11:52). So, we are very very small in the global battery technology as it goes. Most of the batteries we get are all imported.

How the vehicle technology will come? There are lot of things have been done. You have some vehicles in the market, there is a big battery bank and then come the power set. But remember that if there is a vehicle, there is a car or there even could be a bus which has got a battery in there, you have to go charge in at some point of time. So, when charging it, we have dividing it into a grid and so the power supply in this grid came from many power stations of which 80 percent is from coal.

So, what are we doing? We generate electricity with the certain efficiency at the power station, then there is a transmission system in which you do ten twenty percent of the electricity and then we charge it with the certain efficiency and then using that energy, we go certain distance. So, you can do a calculation based on whatever data is there on the web as to how much energy say how many mega joules are required to move a passenger with distance of 1 kilometre.

Take the average occupancy of the car I will say 1.5, you stand on the road and count how many people are there in the car. You can see it 4 or 5 people, but there will average of all cars that will together is about 1.5 is a very very low. And so, you do that calculation and then work back that so much of electricity was consumed here. To get that much electricity, how much electricity did the power plant generate and to get that much electricity, how much coal it burn and then you would calculate mega joules of coal equivalent or oil equivalent per passenger kilometre.

And you quickly see that this is much more energy intensive than any of the technologies, but I want to convey to all of you that do not be too offsets with the car. The car is only going to cause more and more problems. If anybody talks about air pollution in the cities and I have bet there is no city here which does not have a problem. Yes, because we dont have a good public transport system.

Do this calculation for to either a car, a bus, electric train and I also encourage to look up the where in India, we do not have this yet, but fuel cell bus or a fuel cell car. And you

will see that technology is in this side, the bus and the electric train and possibly powered by the fuel cell or by electric traction. They are trained 80 or 100 times more fuel efficient than the car or the motor cycle.

So, in our country has to have a fighting chance to save itself, more cars is only going to cause you more traffic jams, more accidents, more deaths. So, please think about all of this and all of this have got to do with thermodynamics. So, that is that part of the question ok. The other if there any more question, what are you do with I will take those questions and I will pick it up tomorrow and also post up the answer on the website ok.

Thank you. So, tomorrow we meet at 10’ o clock.