Drilling and Blasting Technology
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Lecture - 22
Explosives properties-2

Let me welcome all of you to the lecture number 22 of Drilling and Blasting Technology. Last from last class we are continuing with the Explosive Properties.

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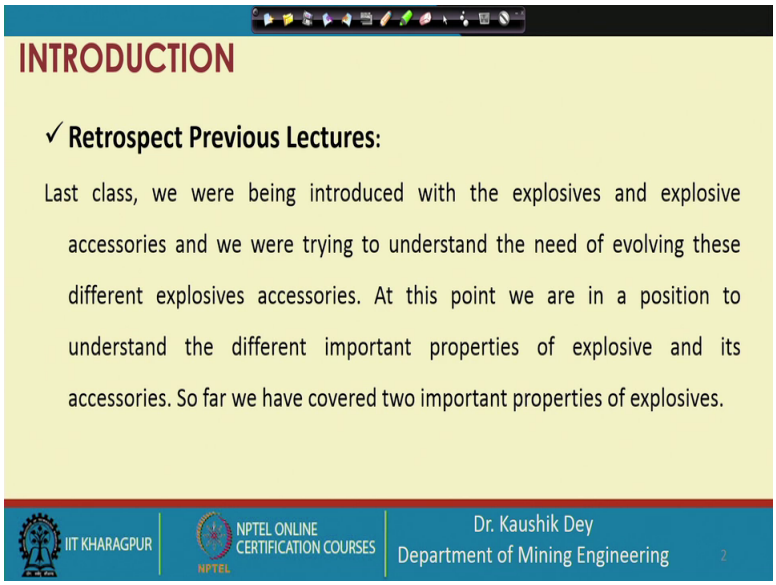

And, let us continue with that. So, as at the very beginning let us retrospect the previous lecture. In last class we are being introduced with the explosive and explosive accessories. And, we have discussed the explosive properties of density and VOD which are very important properties.

But, there are few more important properties they there let us discuss those properties here.

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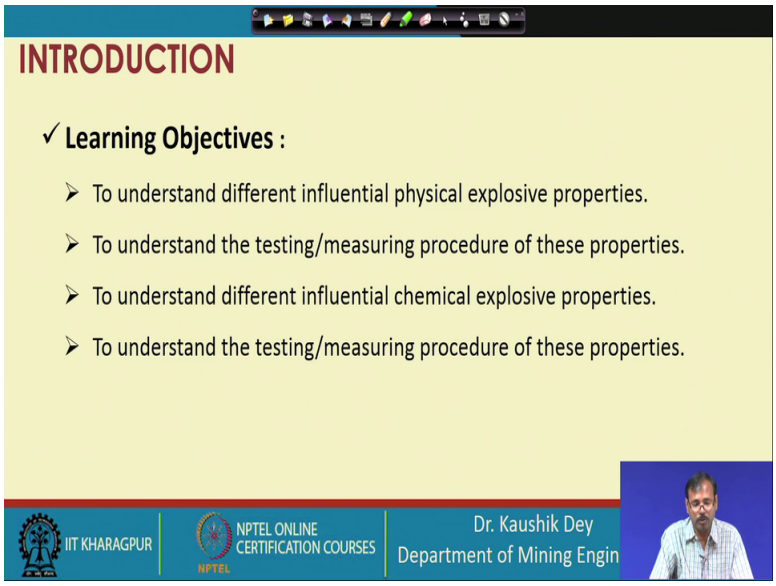

So, objective is learnt our learning objective still remain same from the last class, that we are willing to know the physical explosive properties, chemical explosive properties, and how to what are the testing measurements testing or measuring procedures for those properties, we are trying to understand in this lecture.

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So, like very beginning let us observe another demolition blasting, you can see this is a very multistoried building, which is being demolished by the explosive. You can see how

beautifully the complete building is basically vertically getting down by demolishing, without a little affect to the surrounding.

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So, basically this is one of the extreme this is one of the extreme use of explosive technology the last one is the much better than this one, this is the extreme use of explosive technology for some civil or commercial use. So, if you carry out your demolishing this building using some manual or other mechanical method like, using big hammers or the manual hammerings putting labors.

The time requirement and the cost requirement will be much higher than these cases; you can see the complete area has been demolished using the blasting method maybe in few seconds.

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So, the methods if it is instead of using the explosive, if it is carried out by the mechanical or manual way, probably the time requirement was more than a year in this case it is in few second. So, that is why this demolishing blasting is now adays very popular, especially in case of those where the surrounding populations are very high. And the controlled demolition of the building is essential. So, let us go to our next important property that is strength.

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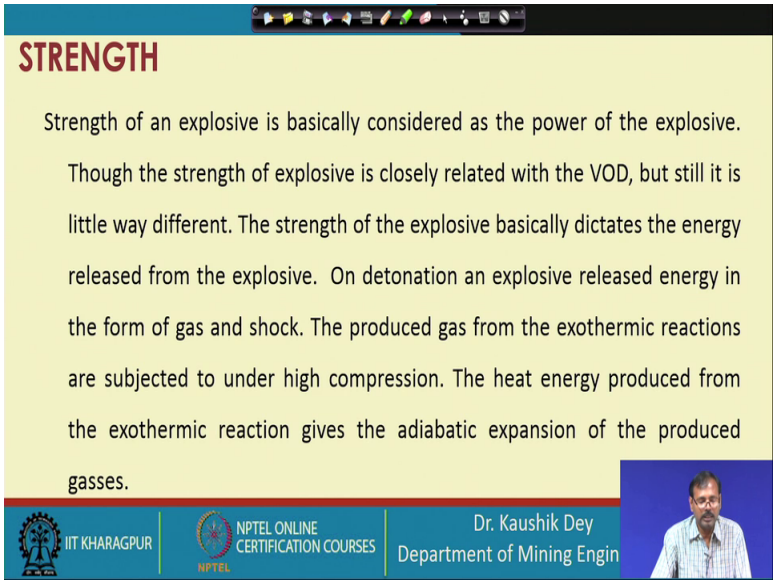

Strength of an explosive strength of an explosive is basically considered as the power of the explosive. Though the strength of the explosive is closely related with the VOD, but still it is little way different. The strength of explosive dictates the energy released from the explosive. So, on detonation an explosive released energy in the form of gas and shock the produce gas from, the exothermic reaction are subjected to high compression because of it is confinement. And, the heat energy produced from the exothermic reaction gives the adiabatic expansion of the expansion or compression of the gases.

So, basically on detonation explosive first produce the shock, then explosive first produce the shock, then the gases are produced and as it is a confined condition, the gases are in highly confined pressure, because the gases are also hot in nature, because of this exothermic reaction.

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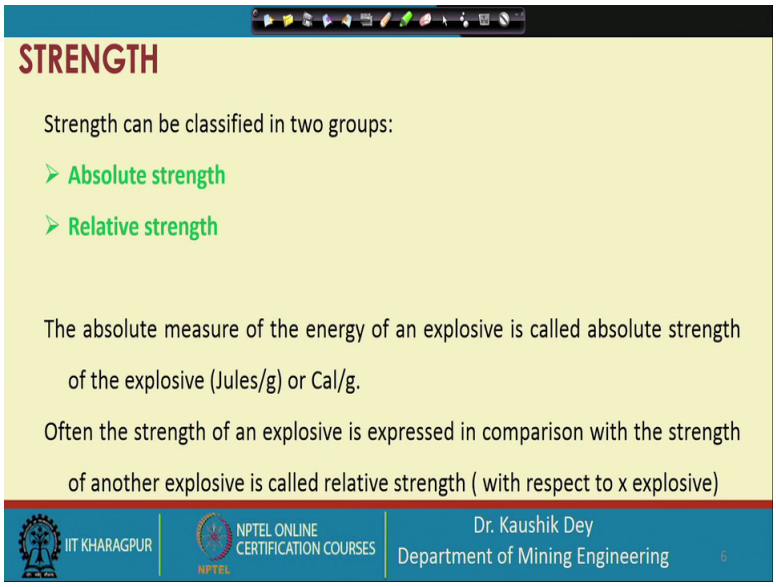

So, basically strength dictates the energy content in the explosive. And that is why the strength can be classified in 2 groups; one is the absolute strength and another is the relative strength. The absolute strength is the absolute measure of the energy of an explosive and often, it is expressed in terms of joules per gram or calorie per gram.

So, this the strength of the explosive, when it is measured in joules per gram or calorie per gram. This is called as the absolute strength. In general the absolute strengths of strength of an explosive is obtained from it is chemical reaction or there are some

empirical formula available, from where the VOD is utilized to get a nearby value of the absolute strength.

Often the strength of an explosive is expressed in comparison with the strength of another explosive whose strength is known is called relative strength. So, when the when with respect to x explosive whose strength is known to as or we can consider that as a base or standard explosive, if we express the strength of some unknown explosive on the proportion and ratio of that explosive, it is considered as the is it is called the relative strength.

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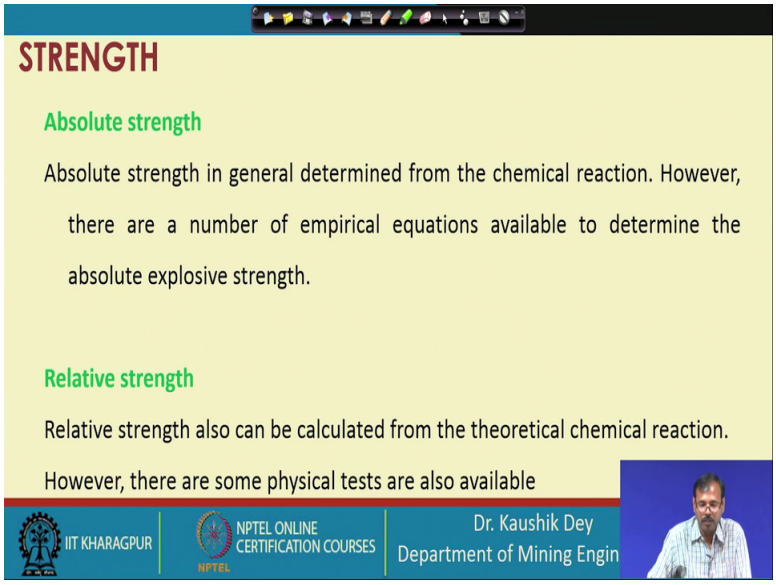

So, absolute strength in general determined from the chemical reaction. However, there are a number of empirical equations available to determine the absolute strength. And relative strength also can be calculated from the theoretical chemical reactions also can be measured from the physical tests.

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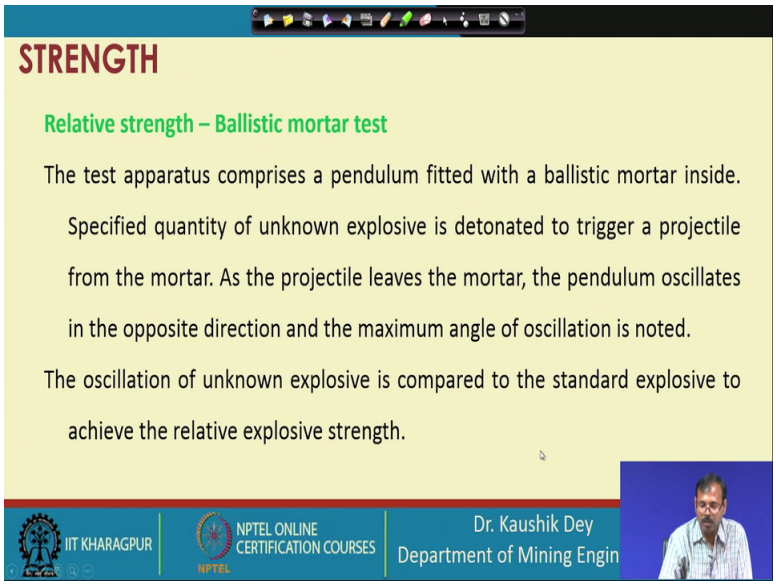

So, this is the ballistic mortar test, which is carried out to measure the relative strength of an explosive. What is the ballistic mortar? Next slide we will see the figure, but ballistic mortar is basically comprises a pendulum fitted with a ballistic mortar inside the pendulum. Specified quantity of unknown explosive is detonated to trigger a projectile from the mortar. As the projector leaves the mortar, the pendulum oscillates in the opposite direction and the maximum angle of oscillation is noted.

The oscillation of unknown explosive is compared with the oscillation obtained from the standard explosive and thus the relative explosive strength is measured.

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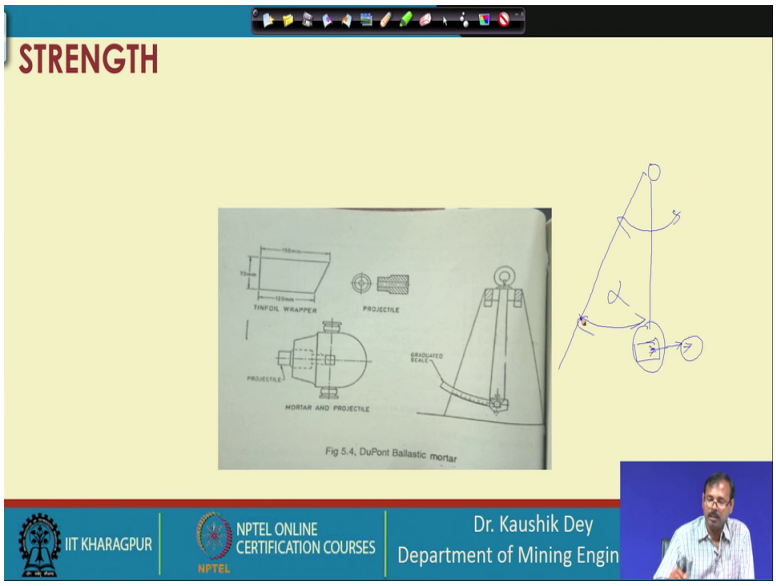

So, this is the ballistic mortar. This is the ballistic mortar, which is placed in a pendulum and you can see the enlarge ballistic mortar, this is the projectile, this is the projectile and the explosive are placed at this position. When the explosive is placed at this position and the detonation is given to this explosive, then the explosive generate shock and huge quantity of gas which throw this projectile towards this direction.

And, then project projectile removes the pendulum from this. So, the projectile removes the pendulum in these direction and allow the pendulum to oscillate in this direction. So, there is a mark on the pendulum, which when which is in the final position, stay at that position and that point is marked on the scale. So, this is the scale which gives us the angle of oscillation.

So, the maximum oscillation angle is monitored and measured on the scale. So, basically in a nutshell it is a pendulum this is a pendulum in which a ballistic mortar is placed, this mortar is allowed to send a projectile in this direction and on reaction of this pendulum oscillates.

And, the maximum oscillation angle this maximum oscillation angle is measured.

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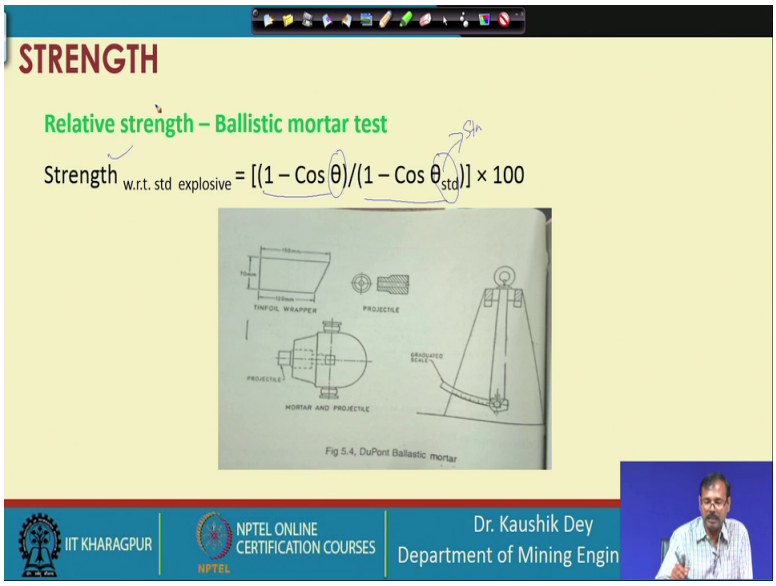

And, the strength of the explosive is calculated using the formula 1 minus 1 minus cos theta by 1 minus cos theta for the standard explosive into 100. So, if we are carrying out the test first with the standard explosive and we measure the theta standard, then we carry out the same test with the same quantity of unknown explosive.

And measure the theta, we can identify the relative weight strength of the explosive. Say here is another classy type of classification possible with this.

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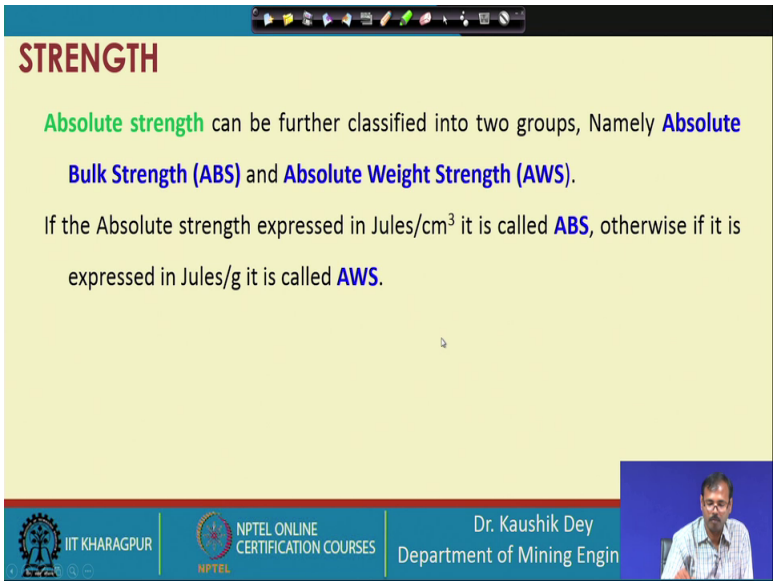

That is the absolute strength again can be classified in the 2 parts; one is the Absolute Bulk Strength, another is the Absolute Weight Strength. Absolute strength when it is expressed in joule per centimeter cube or calorie per centimeter cube is called absolute bulk strength.

Otherwise, if it is expressed in calorie per gram or joule per gram then it is called absolute weight strength. So, when the explosive is expressed in weight and the strength is expressed in joules or calorie in that case it is absolute weight strength. If the explosive is expressed in volume and the strength is expressed in joule or calorie it is called absolute bulk strength.

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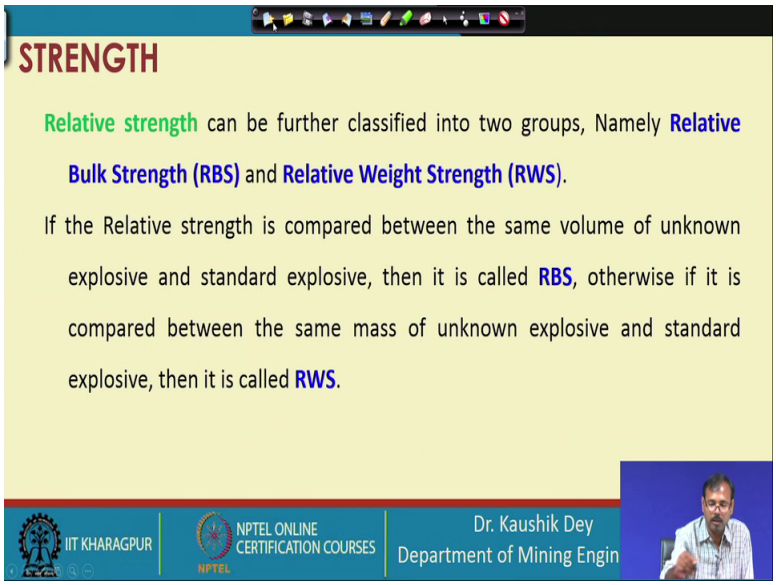

Relative strength can be further classified into 2 groups; one is Relative Bulk Strength, another is Relative Weight Strength. And again as same as if it is expressed in terms of volume it is called relative bulk strength, if it is expressed in terms of weight, then it is called v then it is called relative weight strength.

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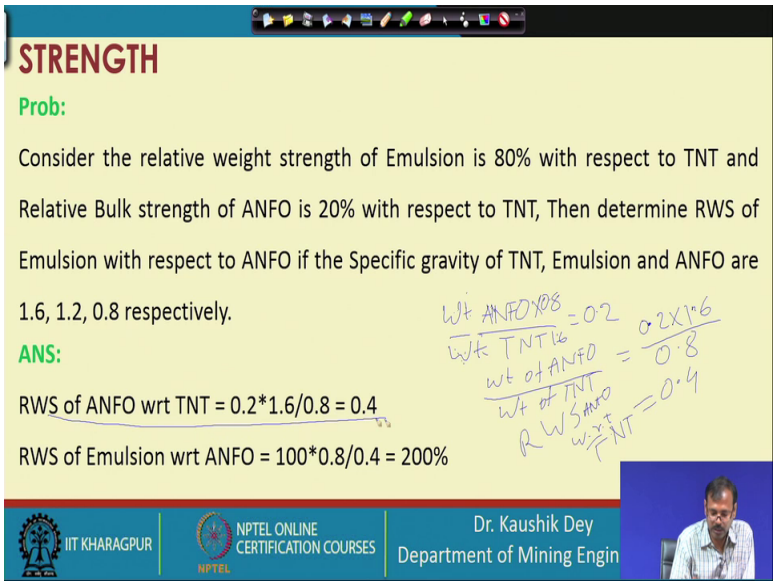

Now, let us let us calculate one problem solve one problem. So, that we can understand the dependency of this strength parameters, the absolute strength parameters, relative of strength parameters, absolute bulk strength parameter, relative bulk strength parameter, absolute weight strength, relative strength parameters, how they are inter dependent to each other? Let us 2 problems we can understand easily by solving these problems.

So, consider the relative weight strength of emulsion is 80 percent with respect to TNT ok. That means the 1 kg of emulsion, how much energy it is producing? That is 80 percent of the energy produced from one kg of TNT.

Second statement is given relative bulk strength of ANFO is 20 percent with respect of TNT. That means, 1 meter cube 1 meter cube of ANFO is exerting 20 percent of the energy 20 percent of the energy produced from the one meter cube of TNT. After, that it is given that the specific gravity of TNT emulsion and ANFO are 1.6 1.2 and 0.8 respectively, then the question is at determine the relative weight strength of emulsion with respect to ANFO.

So, let us solve this problem. Now, relative weight strength of ANFO with respect to TNT comes 0 point t into 1.6 divided by 0.8. How, let us solve this. So, let us solve this by hand say we know the relative bulk strength of ANFO is 20 percent; that means 0.2. So, ANFO same volume of ANFO same volume of TNT is equal 0.2.

Now, let us convert this volume to the weight ok. Then we multiply with the specific gravity here so; that means, if we erase the volume, if we erase the volume make it, if we erase the volume then we make it weight, then this should be multiplied with the density, that is 0.8, and this should be multiplied with the density that is 1.6. So, weight of ANFO; that means, strength obtained from same weight of ANFO, and strength obtained from same weight of TNT is equal to 0.2 into 1.6 divided by 0.8 which comes 0.4.

So, this is nothing, but the relative weight strength of the ANFO with respect to TNT ok. So, the first statement is now clear. Now, let us look into the second part we now we know relative weight strength of ANFO with respect to TNT is 0.4, we know the relative weight strength of emulsion, we know the relative strength of emulsion with respect to TNT is 80.8.

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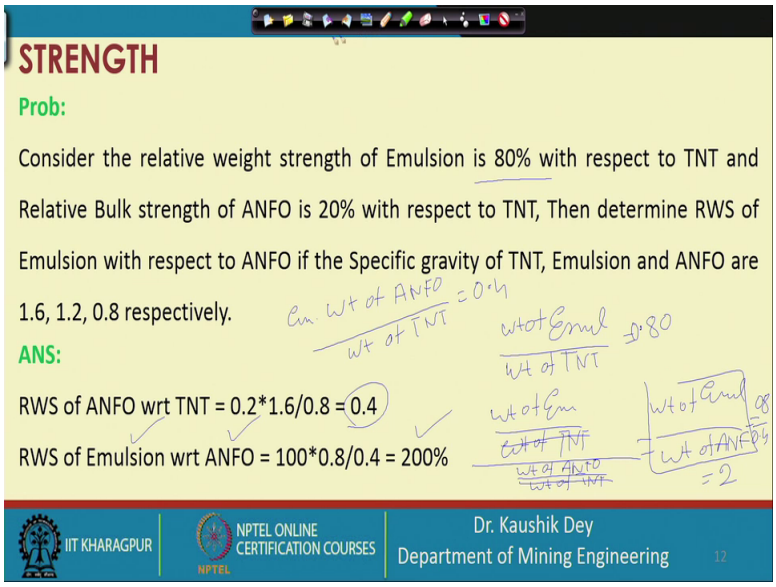

So, weight of emulsion energy obtained from weight of emulsion energy obtained from weight of same TNT is equal to 80 percent; that means, 0.8.

Now, we are having also weight of ANFO energy obtained from energy obtained from weight of ANFO, energy obtained from same weight of TNT is equal to 0.4 as we have calculated at this place. So, if we are dividing these two; that means, weight of emulsion weight of TNT divided by weight of ANFO, divided by weight of TNT, then this part will be cancelled. So, it will become weight of emulsion by weight of ANFO.

And, this value will be 0.8 divided by 0.4; that means, 2 ok. So, this is nothing, but this portion is nothing, but relative weight strength of emulsion with respect to ANFO, that is coming 2 means it is 200 percent. So, basically from this problem we are under we are able to understand, how we can convert the relative bulk strength into the relative weight strength? Ok. So, now, this conversion between the relative bulk strength to weight strength or in other cases bulk strength to weight strength, which may be irrelative or absolute we can do it for the both the cases it is possible from as our understanding we can see from this problem.

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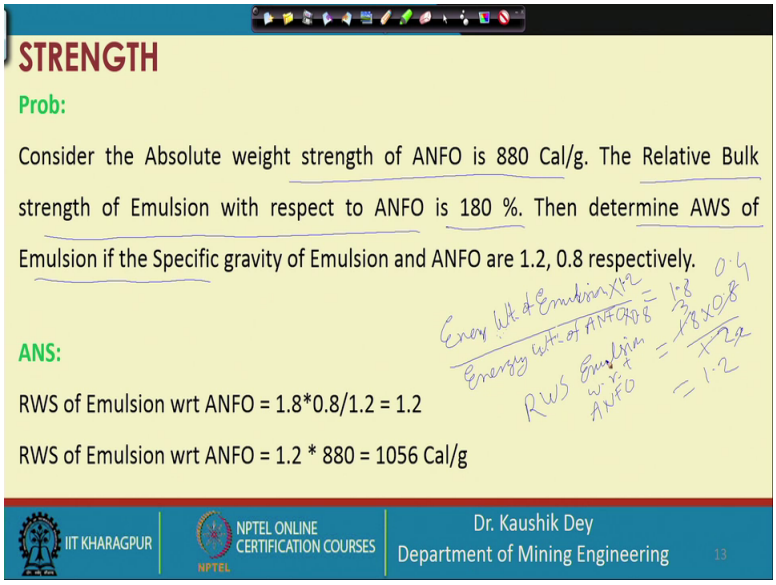

Let us see another problem, in this problem we will try to understand how we can convert between the absolute strength and the weight strength? So, what is the, what is the problem? This problem is that considered the absolute weight strength of ANFO, consider the absolute weight strength of ANFO is 88 calorie per gram, relative bulk strength of emulsion with respect to ANFO is 180 percent then determine the absolute weight strength absolute weight strength of the emulsion, if the specific gravity of the emulsion ANFO are 1.2 and 0.8 respectively.

So, first here what we need to do? We have to find out the how much energy absolute weight strength of the emulsion? So; that means, how much energy we can obtained by detonating one gram of emulsion? So, one part is given absolute weight strength of ANFO is already given to us. So, absolute weight strength of emulsion with respect to

ANFO absolute sorry relative weight strength of emulsion with respect to ANFO can be obtained by this, 1.8 into 0.8 by 1.2 that is the ratio of the density of the explosive.

So, let us elaborate this to understand it is given the weight strength of ANFO top is 88 calorie per gram relative bulk strength of emulsion with respect to ANFO is given; that means, one considering the energy obtained energy obtained from the volume of emulsion volume of emulsion. And energy obtained from the volume of ANFO is equal to 1.8; that means 180 percent. Now, let us convert the volume into weight. So, to convert this volume into a weight, we have to we have to multiply we have to multiply with the density; that means, for emulsion it is 1.2 and for this it is 0.8.

So, now energy obtained from the weight of emulsion, energy obtained from the same weight of ANFO this ratio is nothing, but the relative weight strength of emulsion with respect to ANFO is equal to 1.8 into 0.8 by 1.2 that is equal to 1.2. So, that is coming 1.2. So, this is now easily obtained that relative weight strength of emulsion with respect to ANFO is now known to us.

Now, let us see the second part in second part, we have to determine the absolute weight strength of emulsion.

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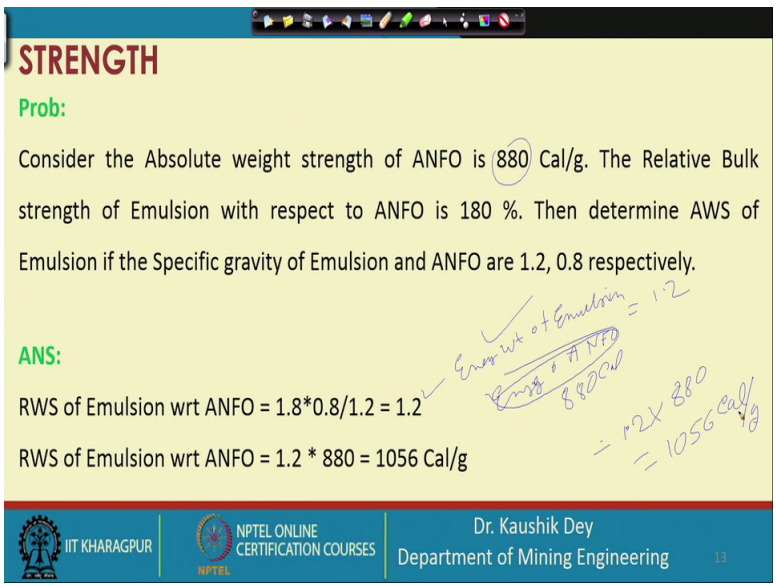

So, we know the weight of emulsion energy obtained from the emulsion divided by energy obtained from ANFO is equal to 1.2 energy obtained from unit weight of ANFO emulsion is nothing, but 88 calorie.

So, energy obtained from the unit weight of emulsion is 1.2 into 88 0 that is coming 1056 calorie per gram.

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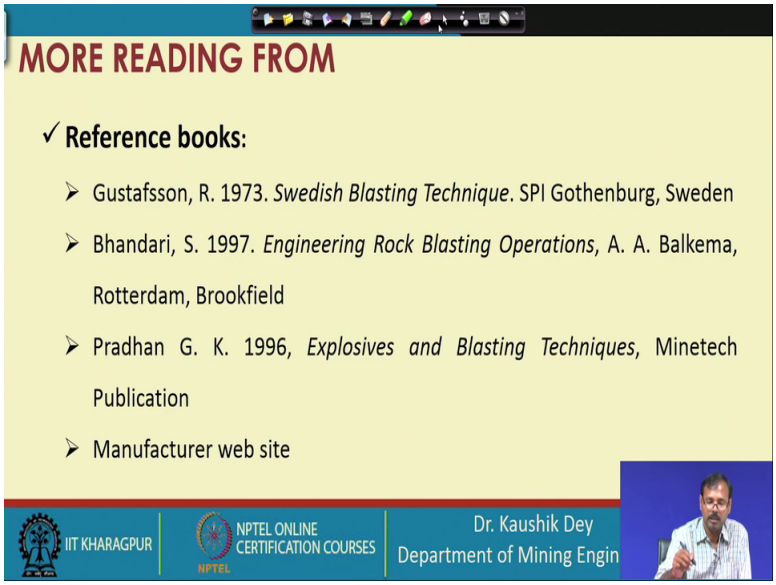

So, we are we are now able to convert between the relative weight strength, absolute weight strength and between the bulk strength and the weight strength. So, from absolute to the relative and from the bulk to the weight, this conversions are possible if we know the density of the explosive, and their relative or some of their relative strength parameters and some of their absolute strength parameters.

If we know those things we can easily determine the strength parameters of any explosive. Now, it is earlier actually the standard explosives are considered as the TNT. Now, it is ANFO is considered as the standard explosive and every time the relative weight strength which is expressed that is expressed in terms of with respect to ANFO considering the weight strength of the ANFO is 100 or bulk strength of the ANFO is 100.

Considering that the strengths are general proposed. So, we can continue the properties of the explosive, in the next class also before that more reading can be carried out from these reference books.

Thank you.