IC Engines and Gas Turbines
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Lecture – 21
Combustion in SI and CI Engines, Pressure Crank Angle Diagram

We will continue our discussion on IC engine.

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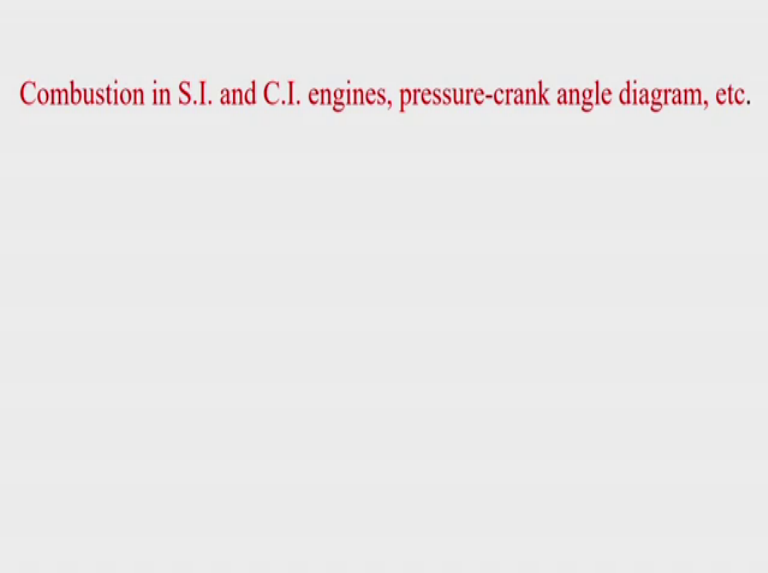

Today we will discuss about com combustion in S.I and C.I engines and then pressure crank angle diagram. So, we will not discussing detail about the combustion, but we will give you know some we will see that, what are the different aspects when you talk about combustion in S.I and C.I engines and is there any difference between the combustion process when we talk about spark ignition engine and compression ignition engine.

So, before we go to discuss about combustion in S.I engine or C.I engines I will just try to discuss about a few important things that I could not discuss in my last lecture that is some alternative fuels. We have discussed about fuels, what are the you know special characteristics of the fuel is, we should look for when we use either for S.I engine and C.I engine and in that context we have discussed about cetane number and octane number.

So, today we will discuss about maybe I will discuss in yes you know in a very short time frame that what is the or why we use alternative fuel, why you need for alternative fuels and what are the you know advantage what are the advantages and disadvantages when we use alternative fuels in the operation of internal combustion engine.

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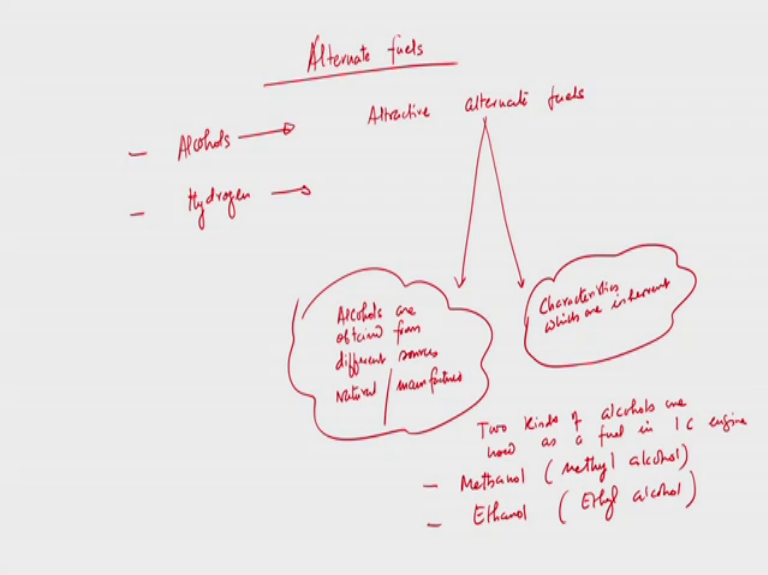

So, you know that we have that you know alternative fuels or alternate fuel; alternate fuels. So, one is that alcohol is very important and then we have hydrogen. So, we know that we can use hydrogen, methane and alcohol as an alternative fuel. So, alcohol, alcohol you know alcohols are very e alternative fuels.

So, these alcohols we may have then we may have hydrogen also we can use natural gas as an alternate fuel. So, alcohol is very attractive as alcohols are very attractive you know alternate fuel and because of what because hydrogen also used as an alternate fuel, but alcohols are attractive alternate fuel because of several reasons; first of all this alcohols can be obtained from different sources can be obtained from a number of sources both natural and manufactured.

So, these alcohols are obtained from different sources natural and manufactured; natural as well as manufactured. So, this is very important number 2 is very important is that among the alternate fuels alcohols you know you know they are promising and you know you know in a recent development recent recently developed engines they are used because of their inherent qualities. So, we will discuss one by one what are the important

features, which are associated with alcohol. So, that we can use alternate we can use alcohol as an alternate fuel in internal combustion engine.

So, they are having you know some characteristics which are inherent in alcohol as an alternative fuel. So, normally two kinds of; two kinds of alcohol are used as a fuel in IC engine. One is methanol; one is methanol or methyl alcohol another is ethanol ethyl alcohol.

So, these two kinds of alcohols are commonly used as a fuel in internal combustion engine, but these are attractive because of they can ob they can they are obtained from different sources may be from natural and also man can be they can be manufactured also there are some characteristics I mean a special qualities which are inherent to this alternate fuels which you know which make them most you know promising and alternate fuel in most of the recently developed engine.

So, we will discuss fine. So, what are the advantages you know what are the advantages of alcohol as a fuel. So, we need to know as I said may be they are obtained from natural and we also can manufactured them, but still see the advantageous features.

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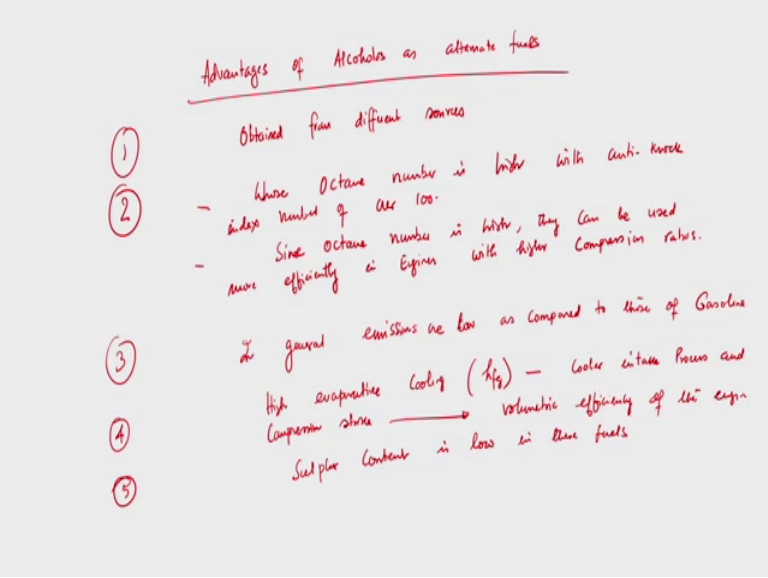

So, advantages of alcohol as alternate fuel as alternate fuel. So, what are those number 1 as I said that obtained from; obtained from different sources which include you know natural you can they can manufactured, number 2 is very important alcohol basically a

fuel whose octane number; octane number is very high octane number is high with antiknock index number octane number is high octane number is high with high with anti antiknock index numbers over 100; with antiknock this is antiknock index number. This is very good quality of the fuel that antiknock index anti antiknock index numbers of over 100.

So, since octane number is high. So, since octane number is high we can use these fuels for a engine which is having higher compression ratio. So, since octane number is high they can be used; they can be used more efficiently; more efficiently in engines with higher compression ratios; higher compression ratios.

So, since octane number is high so we can use these fuels for with more efficiently in engines with higher compression ratio. Number 3 that if we compare to the gasoline these the you know emission rate is low. So, in general emission , emissions are you know low are low as compared to; as compared to gas as compared to those of the gasoline gasoline. So, if we use gasoline as a fuel then we have higher emission so higher rate of emissions, but if we use alcohol as an alternate fuel in internal combustion engine in general emissions are less as compared to those of the gasoline.

Another important is that you know it is having very important is that higher high evaporating cooling. So, this having high evaporative cooling hfg so why out so if you have high evaporative cooling then what will be the extra advantage we can get if you use alcohol as an alternate fuel.

So; that means, we can results in a cooler intake process and compression strokes; it helps to have cooler intake process and compression stroke; compression stroke there were thereby it increases volumetric efficiency of the engine; volumetric efficiency of the engine; that means, if we have high evaporative cooling we can have cooler intake process and compression stroke which in turn increases the volumetric efficiency of the engine and number 5 is very important that sulpher content is low; sulpher content is low in these fuels fine.

So, we have listed down the advantageous features which are there if we use alcohols as alternate fuel. So, whenever we are discussing the advantages features. So, we cannot ignore the disadvantages which are associated with these fuels if we use.

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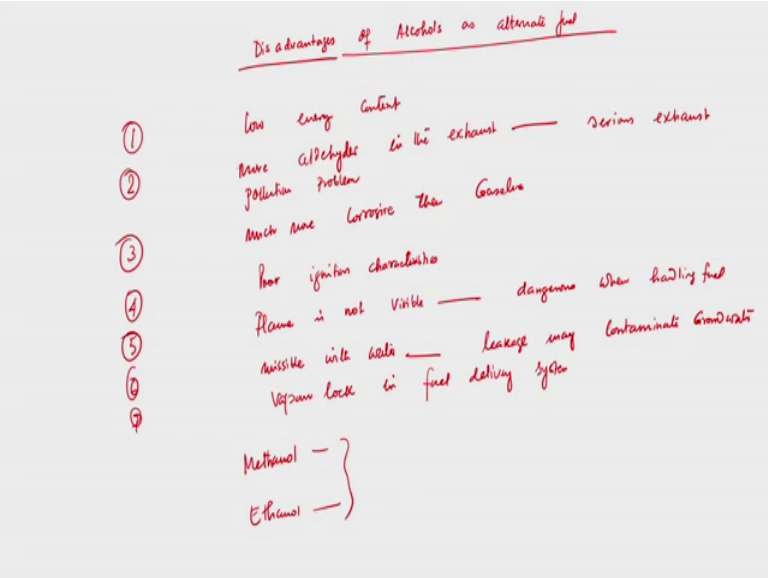

So, what are the disadvantages number 1 similarly I can write disadvantages of alcohols as alternate fuels. Number 1 is very important that low energy content, energy content is not very high low energy content. Number 2 is also that more aldehyde in the exhaust if as much alcohol fuel was consumed as gasoline aldehyde ignition shooter with serious exhaust pollution problem. So, it is having more aldehyde as more aldehyde in the exhaust; more aldehydes in the exhaust; that means, we will have a serious; we will have serious exhaust pollution problem.

Number 3 is also important it is much more corrosion much more it is having much more or much more corrosive than gasoline right. So, these are the disadvantages not only that we are also having several others that is poor ignition characteristics; poor ignition characteristics, number 5 flame which is not visible and sometimes I mean see if flame is not visible, then it may leads to you know severe problem whether we it will be the you know that flame is not visible flame is not visible which becomes dangerous; dangerous when handling fuel.

Also you know since alcohols are missible with water. So, missible with water; that means, leakage may contaminate ground water. So, these are the disadvantages fine. So, we have a you have seen. So, as I said you that methanol in general these are the advantages and disadvantages feature also we have another problem that is called vapor lock vapor lock in fuel delivery systems. As I said you that it is having high evaporative

cooling. So, if it allows us to have cooler intake and as well as cooler intake as well as the compression ratio. So, this vapor lock in fuel delivery system. So, it is having vapor lock in the fuel delivery system. So, these are the disadvantage of alcohol if we use as an alternative fuel.

But as I said you that we use normally methanol and ethanol as alternate fuel, methanol and ethanol these are used has been here for many years basically these two are used for many years in various reasons of the world, I mean these two are these two alcohols are used as an alternate fuel for the many years in different in the world; different countries in the world.

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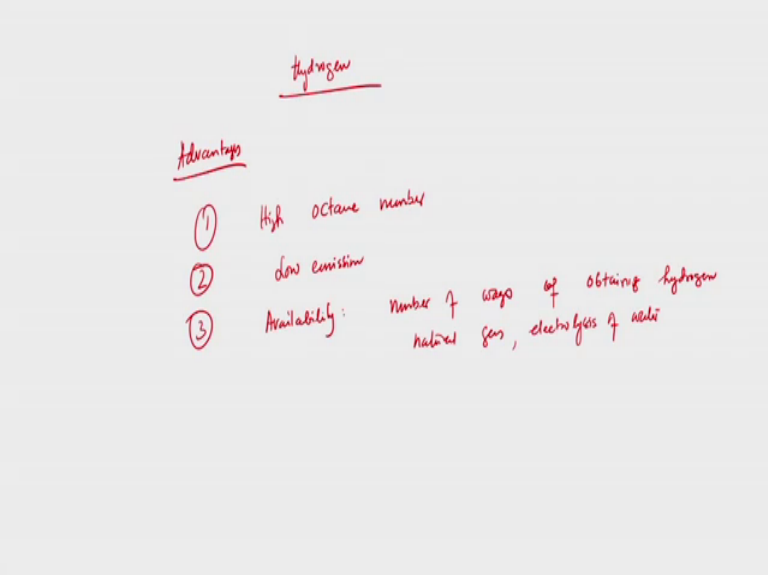

S So, these are the fine apart from this we also can have hydrogen as an alternate fuel so; we can have hydrogen as an alternate fuel. So, you know hydrogen is basically it is used I mean it is a possible measure fuel in of the future to replace you know the eventual dwindling of gas engine supplies. So, if we use hydrogen as a fuel we can have again advantages and disadvantages.

So, advantages are; so hydrogen can replace the eventual dwindling of the gasoline may be supplies because we can have an is it is a very good alternate fuel we can use. So, advantage is that it is having high octane number; high octane number right, low emission as I said you high octane number we can use with higher compression ratio, so availability there are number of ways of having obtaining hydrogen, hydrogen may be

you know natural gas number of ways of we had then natural gas or electrolysis of water etcetera.

So, these are the advantageous features. So, we can use we can use while through (Refer Time:17:29) of water and natural gas, but one of the important problem is that we have to compressed otherwise, handling such amounts such volume of hydrogen it will be difficult. So, storage could be a problem until, unless we can liquefied it. So, that will be only the problem otherwise we can use hydrogen as a good you know alternate fuel in most of the internal combustion engine ok.

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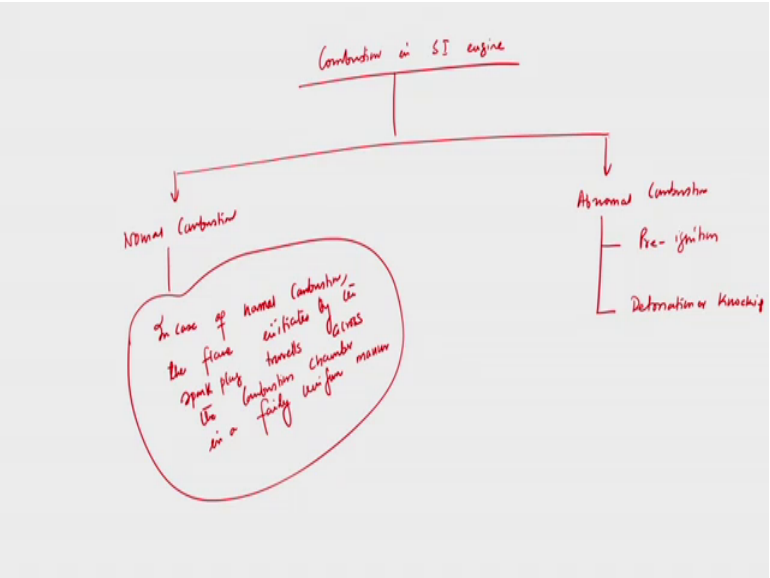

So, now we should move to discuss about few combustion we will discuss not may be in not in detail, but we will discuss. So, at first we will discuss combustion in S.I engine. So, what is combustion in S.I engine? This combustion in S.I engine can be broadly classified into 2 different category we will discuss one by one because we have if you can try to recall that during intake stroke in most of the ee internal S.I engine we have taken air fuel mixture through carburetor.

We will discuss in one among in next lecture that probably next or next lecture that now a days this carburetor through the carburetion is replaced by fuel injection system and what are the problems we have discussed if we have you know carburetion sys carbureted system in supplying the air fuel mixture into the S.I engine and how you know we can remove those problems if we use fuel injection system whatever it is.

So, we take fuel air mixtured or charged during intake stroke then you compress it and at the end of the compression we need to switch on the spark plug and as a result of which we have high pressure and temperature rise and then entire combustion will be completed.

So, this whenever combustion is taking place in inter S.I engine there we can classify combustion into two different categories one is known as normal combustion another is known as abnormal combustion. Abnormal combustion is in classified two different categories one is known as pre ignition we will discuss in detail another is known as detonation or knocking, this is very you know undesirable phenomena detonation or knocking.

So, let me tell you combustion is essentially appearance of visible flame. So, when we have combustion may be which ignite a charge using a spark plug. So, that that leads to the total combustion and entire charge take part as a result of which we have ri pressure rise in pressure and temperature. So, com the appli combustion is you know that is whether combustion is combustion has started or combus oh the entire charge or you know combusted that is basically you know realized through the visible flame. So, the appearance of visible flame indicates that combustion has started.

So, in case of a normal combustion; in case of a normal combustion; in case of normal combustion the flame that is being produced; the flame initiated or produced initiated by the spark plug travels across the combusted across the combustion chamber in a fairly uniform manner.

So, in case of a normal combustion as I said you that the combustion is basically realized to the appearance of visible flame in the combustion chamber in case of a normal combustion when we start the spark plug; that means, a flame that is being initiated developed by the spark plug that travels across the combustion chamber in a fairly uniform manner there is no certain disturbance.

So, this is normal combustion, but it is very unlikely that we will have a normal combustion in most in almost all the internal combustion engines of course, in a spark ignition engine while abnormal combustion we may not have a fairly uniform rather ee uniform movement of the flame rather in a fairly uniform manner rather the flame that is being developed, that is being produced, that is being initiated in from the spark that

when it travels you know in the combustion chamber that is that is getting disturbed by different other flames and it leads to one undesirable phenomenon which is known as detonation and knocking.

We will discuss by how the flame that is being developed or that is being initiated by the spark plug is getting disturbed because of the other flames and whenever we are talking about other flames in the combustion chamber what is the sources what are the sources of that small flame or flames in the combustion chamber in detail and because of what we will have a erratic movement of the main flame that is being produced by the spark plug and sometimes it leads to an undesirable phenomena of detonation and knocking.

So, we will discuss in detail and also we will discuss in detail about the pressure raised in the combustion process that that and if we you know switch on the spark plug may be little away little before the it occurrence also because of preignition we can we will see that the pressure rise in the combustion chamber will be even higher and it and it sometimes leads to an underisil yes sometimes leads to the you know reduction in efficiency of the internal combustion engine.

So, we will discuss those aspects in detail and also we will discuss that whenever you are having this erratic movement of the main flame being produced by the spark plug and leading to detonation and knocking in the internal combustion engine of course, spark ignition engine what are the preventive measure we can take essentially to prevent essentially to stop that erratic movement or I cannot say that we can really stop that, but rather we can reduce the occurrence of such events in the internal combustion engine. We will discuss with aspects in detail in my next lecture. So, with this I stop here now and I will continue my discussion in the next lecture.

Thank you.