Get Hot on Combustion!

By Thomas Yoon

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Energy in the form of heat is obtained when fuel is burnt in air. The release of this heat energy can be slow or can be very rapid.

When fuel oil is sprayed as a fine mist in the boiler burners, it is able to burn at a relatively slow rate. When fuel is sprayed into the cylinders of diesel engines, the fuel burns in such a rapid rate that explosions occur. Fortunately, these explosions are protected from persons as these engines are called internal combustion engines.

Whatever type of combustion, it is a chemical reaction between carbon, hydrogen, sulphur and oxygen.

$C + O_2 = CO_2$
$2CO + O_2 = 2CO$
$2H_2 + O_2 = 2H_2O$
$S + O_2 = SO_2$
$2S + 3O_2 = 2SO_3$

Air consists of 77% Nitrogen and 23% Oxygen by mass. For a particular design of combustion air, the theoritical oxygen multiplied by 100/23 will give the theoritical air required.

How do you measure a good combustion. The percentage of Oxygen or Carbon Dioxide will tell us whether the combustion is good or not good.

The lower the Oxygen content in the exhaust gas, the better the combustion. It means that the Oxygen has been fully utilized for burning. It also means that the fuel air ratio is set properly. Too much excess air is no good because the heat generated will be lost through the exhaust trunking.

Boilers are able to achieve a good combustion. Oxygen content percentage of up to 5% or lower can be achieved.

Internal combustion engines have a lot of excess air because mixing of the combustible mixture is a challenge for them. Furthermore, the combustion is meant to provide the power to drive the pistons.

The burning of sulphur in the fuel is a problem for combustion equipment. This is because the byproducts of combustion will create sulphur dioxide and sulphur trioxide. These will react with the water, also a byproduct of combustion of Hydrogen to form sulphuric acid and sulphurous acid.

$SO_3 + H_2O = H_2SO_4$
$SO_2 + H_2O = H_2SO_3$
$2H_2SO_3 + O_2 = H_2SO_4$

However, the effects of corrosion, called low temperature corrosion can be avoided by keeping the

temperature above the dewpoint. That means to keep the exhaust temperature high so that water droplets will not form on the exhaust ducts.

Folks, get hot! Too much heat can cause wrinkles!

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Many years of working experience in Marine, Facilities, Construction has given the author material for writing e−books and articles related to engineering, and management.

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Inside Knowledge About Diesel Engines

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One of the most reliable internal combustion engines around is the diesel engine. In many industrial installations, diesel engines are used as prime movers for the generation of electricity and for emergency air compressors.

It's true that they are rugged, but one of the most important advantages of these engines is the fact that they can be

started by manual cranking. In remote areas, diesel engines can be counted upon for starting up from scratch.

Once a small diesel engine is started, it can be used to drive a small electrical generator that can then be used to produce electrical supply for driving other machines like pumps, compressors, and for lighting.

How does a diesel engine work?

First there must be combustion of fuel. As we have discussed in our previous articles, combustion or burning of fuel occurs whenever there is sufficient heat, fuel and oxygen. When conditions are just right, combustion can be very rapid. Rapid combustion causes an explosion in an enclosed area. This is because of the rapid built−up of hot gases during the process.

In an internal combustion engine like a diesel engine, this rapid combustion, and built−up of hot gas pressure is used to push a piston away from the enclosed combustion space.

The piston is attached to a crankshaft through a connecting rod. Because of this, the engine is able to convert the linear movement of a piston to a rotating movement of a crankshaft.

The outward movement of the piston turns the crankshaft. However, the momentum of the turning crankshaft forces the piston back again towards the engine combustion space in a reciprocating movement.

Once the piston moves away from the combustion space, the pressure drops. The next stage of operation depends on the design of the engine. These can be either 2−stroke or 4−stroke designs.

Regardless of the type of design, the spent exhaust gas is first driven out, and then new fresh air is drawn back into the combustion chamber.

After this, the rotating crankshaft drives the piston to compress the fresh air inside the combustion chamber. The piston acts as a reciprocating compressor at this stage.

The compression of the air causes the latter to become hot − hot enough to ignite finely distributed fuel particles.

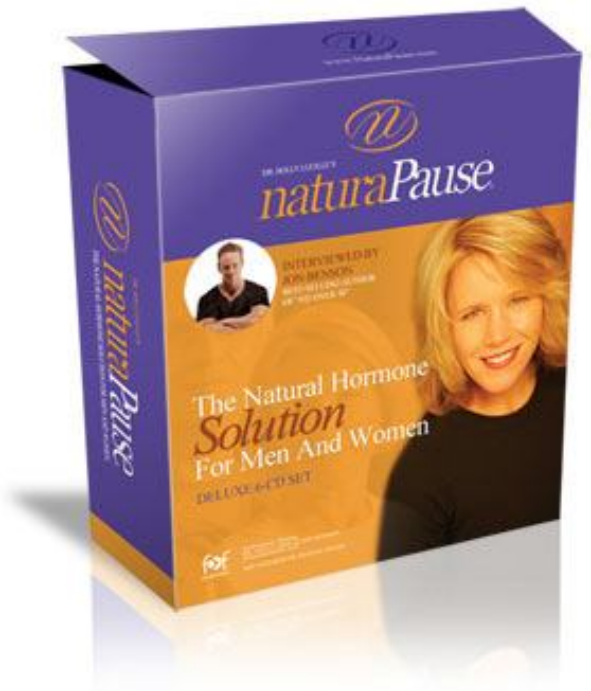
At this moment, fuel is sprayed in at high pressure. The tiny sprayed fuel particles form a mist inside the combustion chamber.

What do think will happen when you have heat, fuel and oxygen? A fire! Each tiny particle of the fuel burns rapidly, and an explosion occurs.

The cycle starts again, and the crankshaft turns continuously, the pistons move continuously, and the engine runs.

How does the engine know when to spray fuel, let in air, compress the air, and exhaust the spent combustion product?

Well folks, start your engines.



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