Promise of New Technology

Reducing emissions

GTL Technology

The Fischer-Tropsch process has been around for a long time used for conversion of coal to liquid hydrocarbons including diesel. Now it is being used to produce cleaner diesel fuels. The diesel fuel produced by the Fisher-Tropsch process, however, is not only of much higher cetane rating than the conventional product but also far superior in terms of emissions. Because the process demands sulphur-free gas feedstock, the diesel contains virtually no sulphur (1ppm). It is also now in aromatics (3 vol%), thus greatly reducing soot formation and particulate emissions.

Diesel Combined Cycle

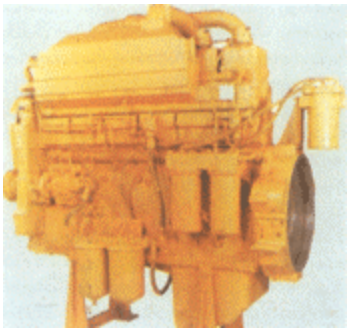
In recent years, the power industry has had to respond to several changes, including the rapid rise in power demand in emerging markets, the increasing popularity of private power generation and stringent environmental regulations. Together, these trends have prompted the development of advanced power generating systems, particularly in diesel engines. This has led to the emergence of the diesel combined cycle (DCC) plant. In addition, the attempt to enhance plant efficiency has led to the development of the hot combustion process.

The focus of this research and development work has been to increase the process media temperatures involved with combined cycle, and to partially eliminate engine cooling in order to further reduce engine low-grade losses. Overall, of course, the objective is to increase the efficiency of primary electrical generation.

The concept of the high-efficiency DCC plant is based on increased exhaust gas heat compared to conventional diesel power plants equipped with heat recovery steam generation systems. Exhaust gas temperatures can be increased by a combination of design and tuning, with the conventional process replaced by a “hot combustion” process. The principle behind the hot combustion process involves the reduction of the diesel engine’s low temperature cooling losses, thereby maximising the heat content in the exhaust gases. This makes it possible to convert waste heat into electricity in a more optimal way, resulting in improved plant efficiency.

Development of the hot combustion DCC system to improve efficiencies has been done on the basis of the utilisation of heavy fuel oils. However, in spite of the potentially high emissions of pollutants from such fuels, a plant powered by hot combustion DCC would maintain low emission levels. The high electrical efficiencies along with complete combustion ensure that only NO_x and SO_x emissions would require attention. Such a plant would be equipped with NO_x catalysts as well as a desulphurisation system, thus keeping emissions low.

Hot combustion diesel engines are at present being tested at a pilot plant.



Bio-Fuel-Based Diesel Engines

Recent research on developing systems for using biomass in diesel plants has focused on converting biomass into liquid fuels. This has resulted in easier handling and use of biomass. The technology for producing and utilising bio-fuels like alcohols and vegetable oils has already been developed and extensively tested. However, high processing and raw material costs have prohibited commercial production.

One technique which has been identified as a high efficiency, low-cost method of producing liquid bio-fuel is flash pyrolysis. In this process, wet wood is dried in a flue gas rotary dryer to a 10 per cent moisture content and ground to a minimum particle size of 6 mm. This is then fed into a reactor which has a temperature of $450^{O}C$ to $550^{O}C$. The wood is rapidly converted into organic vapours and char.

The vapours pass through the condenser where the primary bio-fuel oil product is condensed and separated from non-con-densing gasses. A filter removes solids from the liquid product. From the dry wood, 70 to 72 per cent (weight) of bio-oil and 10 to 15 per cent of charcoal are recovered. The rest is a non-condensible gaseous product.

A diesel engine manufacturer who has been trying to use bio-oil to generate electricity on a sustained basis will use a 250 kW dual fuel slow speed engine which has been modified and developed to accept bio-oil as the main fuel. According to the manufacturer, exhaust emissions from the engine have been very low.

Fuel/ Oxygen Control

The Argonne National Laboratory has claimed an environmental breakthrough that will enable diesel engines to operate cleanly and more efficiently. The new technique controls fuel and oxygen levels in diesel engines and results in reduced particulate levels and decreased nitrogen oxide emissions simultaneously. Nitrogen oxide is precursor to ozone and contributes significantly to smog. This technology increase engine power as well. Changing of oxygen levels and engine operating conditions improves the combustion process, thereby lowering emissions.

Reference book:
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