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Fossil Fuel Green Power Production and Cogeneration

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Abstract -The main aim of this technical paper on fossil fuel green power production and cogeneration, cogeneration is the combination of power (energy) and heat. Here in this technical paper the power production without harming the environment is discussed. Nowadays electricity is in demand. In order to full fill this we can get the electricity by means of fossil fuels, and we can also generate heat, emission of carbon dioxide is reduced. Cost Efficiency is low. It also talks about benefits application efficiency and cogeneration technology.

INTRODUCTION:

Fossil fuels have been the primary source of energy for propelling all manmade wonders. The main aim of this technical paper is about power production using fossil fuels and cogeneration. This technical paper deals with the preparation of power using fossil fuels. Here this paper is discussed about coal which is a fossil fuel used for power generation and its structure, chemical reaction and its uses in various fields. It also deals with advantages and disadvantages of coal for power production.

Types of fossil fuels and its production:

Coal

It is a fossil fuels extracted from animal and plant waste which is buried in the ground for millions of decades.

Petroleum

The liquid hydrocarbon undergoes various stages and process of refinement and modification to give different fuel product such as petrol, petro diesel, kerosene etc.

Natural gas

This liquid hydrocarbon undergoes various stages and processes of refinement and modifications to give us different fuel products such as petrol, petro diesel, kerosene, etc. Gaseous hydrocarbons (such as methane) derived from marine fossil fuel sources such as plankton decays and algae that re-used as a fuel source come under the category of natural gas.

Orimulsion

Orimulsion is extracted from bitumen and it was first discovered by Intevep. The name Orimulsion is the registered trademark name of this bitumen based fuel and it occurs naturally in Venezuela's Orinoco Belt.

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Orimulsion is extracted from bitumen by mixing the latter with about a third of its volume of water and a residual quantity of surfactant Are some of the fossil fuels.Fossil fuel power station have rotating machinery to convert the heat energy of combustion into mechanical energy, which then operates an electrical generator. The prime mover may be a steam turbine, a gas turbine or, in small plants, a reciprocating internal combustion engine. All plants use the energy extracted from expanding gas - steam or combustion gases. Very few MHD generators have been built which directly convert the energy of moving hot gas into electricity. Where MHD means magneto hydrodynamics. By products of thermal power plant operation must be considered in their design and operation. Waste heat energy, which remains due to the finite efficiency of the Carnot, Rankine, or Diesel power cycle, is released directly to the atmosphere, directly to river or lake water, or indirectly to the atmosphere using a cooling tower with river or lake water used as a cooling medium. Fossil fuel power stations are major emitters of CO_2, a greenhouse gas (GHG) which according to a consensus opinion of scientific organisations is a contributor to global warming as it has been observed over the last 100 years. Brown coal emits about 3 times as much CO_2 as natural gas, and black coal emits about twice as much CO_2 per unit of electric energy.Carbon capture and storage of emissions is not expected to be available until governmental regulations force big polluters to reduce or eliminate their CO_2 emissions.

Advantages and disadvantages of fossil fuels:

Advantages

- Fossil fuels have a very high calorific value. Thus, burning 1 gm of fossil fuel releases tremendous amount of energy. Thus, the energy produced by fossil fuels is greater than that produced by an equivalent amount of other energy resource.
- The reservoirs of fossil fuels are pretty easy to locate with the help of advanced equipment and technology.
- Coal is a fossil fuel that is found in abundance. It is used in most power plants because it reduces the production cost to a great extent.
- Transportation of fossil fuels that are in liquid or gaseous forms is very easy. They are simply transported through pipes.
- Construction of power plants that work on fossil fuels is also easy.
- Petroleum is the most predominantly used form of fossil fuels for all types of vehicles.
- Fossil fuels are easier to extract and process, hence are cheaper than the non-conventional forms of energy.

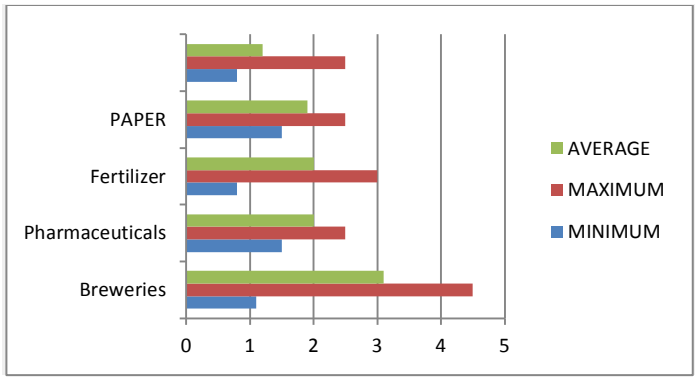
Disadvantages

- Although, oil, natural gas and coal are found in abundance in nature, the alarming rate at which they are being consumed has resulted in substantial depletion of their reservoirs. Besides, it is impossible to replenish the resources as it takes millions of years for the hydrocarbon chains to form from organic remains.
- The hydrocarbons present in the fossil fuels, release greenhouse gases, such as methane, carbon dioxide etc., which are capable of damaging the ozone layer
- Besides, other harmful gases such as carbon monoxide and sulfur dioxide are responsible for acid rain, which has spelled disaster for the ecology.
- Extraction of fossil fuels has endangered the environmental balance in some areas. Moreover, coal mining has jeopardized the lives of several mine workers.
- The depletion of reservoirs has made the extraction of fossil fuels an expensive affair. This is likely to affect the fuel prices in near future.
- Leakage of some fossil fuels, such as natural gas, crude oil can lead to severe hazards. Hence, transportation of these fuels is very risky.

COGENERATION:

Combined heat and power(CHP), also known as cogeneration, is the simultaneous production of electricity and heat from a single fuel source, such as: natural gas, biomass, biogas, coal, waste heat, or oil," EPA reports. Cogeneration was likely first introduced by Thomas Edison in 1882 at his Pearl Street Station, which combined heat and power, producing electricity and thermal energy. Environmentally friendly, the majority of today's large industrial and commercial CHP applications are in the pulp and paper, chemical, refining, food processing, ethanol, and manufacturing sectors, which require vast amounts of electricity and heat and typically run on natural gas, generally believed to be the cleanest fossil fuel. Cogeneration exemplifies a demonstrated, cost-effective, and energy-efficient solution for delivering electricity and heat. Newer technologies such as fuel cells, with their small-scale applications, also play an important role in cogeneration's future.

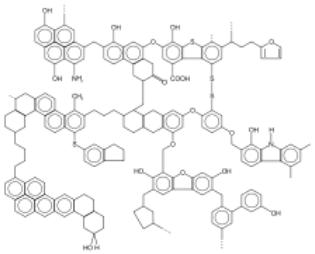
Typical Heat: Power Ratios for Certain Energy Intensive Industries



Thermal power plants are a major source of electricity supply in India. The conventional method of power generation and supply to the customer is wasteful in the sense that only about a third of the primary energy fed into the power plant is actually made available to the user in the form of electricity. In conventional power plant, efficiency is only 35% and remaining 65% of energy is lost. The major source of loss in the conversion process is the heat rejected to the surrounding water or air due to the inherent constraints of the different thermodynamic cycles employed in power generation. Also further losses of around 10-15% are associated with the transmission and distribution of electricity in the electrical grid. So to overcome we use cogeneration process.

Usage of coal for power generation:

Coal is the world's most abundant and widely distributed fossil fuel with reserves for all types of coal estimated to be about 990 billion tonnes, enough for 150 years at current consumption (BGR, 2009).1Coal fuels 42% of global electricity production, and is likely to remain a key component of the fuel mix for power generation to meet electricity demand, especially the growing demand in developing countries.Coal plays a vital role in electricity generation worldwide. Coal-fired power plants currently fuel 41% of global electricity. In some countries, coal fuels a higher percentage of electricity.



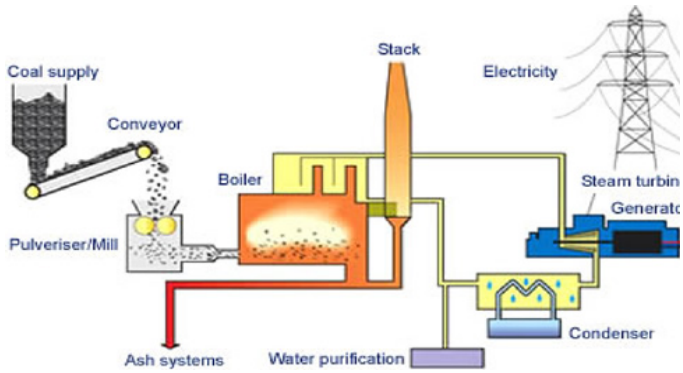
Chemical structure of a coal

coal converted to electricity:

Steam coal, also known as thermal coal, is used in power stations to generate electricity.Coal is first milled to a fine powder, which increases the surface area and allows it to burn more quickly. In these pulverised coal combustion (PCC) systems, the powdered coal is blown into the combustion chamber of a boiler where it is burnt at high temperature (see diagram below). The hot gases and heat energy produced converts water – in tubes lining the boiler –

into steam. The high pressure steam is passed into a turbine containing thousands of propeller-like blades. The steam pushes these blades causing the turbine shaft to rotate at high speed. A generator is mounted at one end of the turbine shaft and consists of carefully wound wire coils. Electricity is generated when these are rapidly rotated in a strong magnetic field. After passing through the turbine, the steam is condensed and returned to the boiler to be heated once again.

The electricity generated is transformed into the higher voltages (up to 400,000 volts) used for economic, efficient transmission via power line grids. When it nears the point of consumption, such as our homes, the electricity is transformed down to the safer 100-250 voltage systems used in the domestic market.



Preparation of electricity using coal

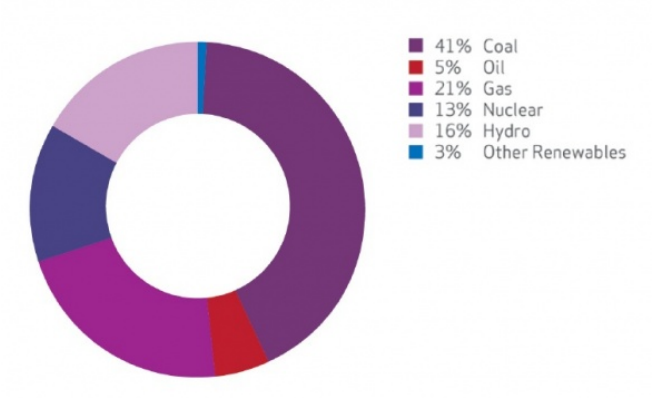
Coal in Electricity Generation		
South Africa 93%	Poland 87%	PR China 79%
Australia 78%	Kazakhstan 75%	India 68%
Israel 58%	Czech Rep 51%	Morocco 51%
Greece 54%	USA 45%	Germany 41%

In electricity generation based on coal india ranked 6 with 68%

Efficiency Improvements:

Improvements continue to be made in conventional PCC power station design and new combustion technologies are being developed. These allow more electricity to be produced from less coal - known as improving the thermal efficiency of the power station. Efficiency gains in electricity generation from coal-fired power stations will play a crucial part in reducing CO2 emissions at a global level. Efficiency improvements include the most cost-effective and shortest lead time actions for reducing emissions from coal-fired power generation. This is particularly the case in developing countries where existing power plant efficiencies are generally lower and coal use in electricity generation is increasing. Not only do higher efficiency coal-fired power plants emit less carbon dioxide per megawatt (MW), they are also more suited to retrofitting with CO_2 capture systems.

Improving the efficiency of pulverised coal-fired power plants has been the focus of considerable efforts by the coal industry. There is huge scope for achieving significant efficiency improvements as the existing fleet of power plants are replaced over the next 10-20 years with new, higher efficiency supercritical and ultra-supercritical plants and through the wider use of Integrated Gasification Combined Cycle (IGCC) systems for power generation. A one percentage point improvement in the efficiency of a conventional pulverised coal combustion plant results in a 2-3% reduction in CO2 emissions.



Total World Electricity Generation by Fuel

Advantages and disadvantages of coal

Some advantages of coal are -

- Easily combustible, and burns at low temperatures, making coal-fired boilers cheaper and simpler than many others
- Widely and easily distributed all over the world;
- Comparatively inexpensive to buy on the open market due to large reserves and easy accessibility
- Good availability for much of the world (i.e. coal is found many more places than other fossil fuels)
- Most coal is rather simple to mine, making it by far the least expensive fossil fuel to actually obtain
- Coal-powered generation scales well, making it economically possible to build a wide variety of sizes of generation plants.
- A fossil-fuelled power station can be built almost anywhere, so long as you can get large quantities of fuel to it. Most coal fired power stations have dedicated rail links to supply the coal.

Disadvantages of coal:

- An average of 170 pounds of mercury is made by one coal plant every year. When 1/70 of a teaspoon of mercury is put in to a 50-acre lake it can make the fish unsafe to eat.
- Coal power puts the lives of the people who dig the coal in danger, and it gives them poor lung quality. Also, it ruins the natural habitats of animals.

- A coal plant generates about 3,700,000 tons of carbon dioxide every year ;this is one of the main causes of global warming.
- A single coal plant creates 10,000 tons of sulphur dioxide, which causes acid rain that damages forests, lakes, and buildings.
- When people dig for coal, they cut down many trees.
- A coal plant also creates 720 tons of carbon monoxide; which causes headaches and place additional stress on people with heart disease.
- A 500-megawatt coal- fired plant draws about 2.2 billion gallons of water from near by bodies of water. This is enough water to support approximately 250,000 people.
- Some people have said that coal power is good, because coal power is reliable and affordable. It may be reliable and affordable, but in the future the damage that coal power would cause, would be much more expressive.

Conclusion:

Modern life is unimaginable without electricity. It lights houses, buildings, streets, provides domestic and industrial heat, and powers most equipment used in homes, offices and machinery in factories. Improving access to electricity worldwide is critical to alleviating poverty. Technological innovation will allow demand for coal to be met without an unacceptable environmental impact. The country is now 99% Electrified, with around 77% of the electricity produced in coal-fired power stations.

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