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A STUDY ON BIO-MASS HEAT ENERGY CONVERSION SYSTEMS FOR POWER ENERGY SYSTEMS

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ABSTRACT:

Until the industrial revolution, humankind relied almost exclusively on biomass for their energy needs. Most of the biomass is burnt to provide heat for cooking or warmth. Some is used for small industrial applications (For instance, Charcoal is used in steelmaking in countries like Brazil, which have no major coal reserves). A small percentage of biomass is also used to generate electricity. Biomass energy accounts for around 14% of total primary energy consumption. This bold figure hides a major disparity between the developed and the developing world. Estimates of the amount of energy that can be supplied from biomass too vary widely, but according to some estimates, by 2050 it could provide as much as 50% of global primary energy supply. Generating electricity from biomass is perhaps one very attractive and easy option to make use of this valuable resource. It uses exactly the same technology that has become common in the power generation industry - furnaces to burn coal, boilers to raise steam from the heat produced and steam turbines to turn the steam into electricity. This paper describes about the study of application conversion in bio-mass to energy utilization in different ways.

Keywords: *Bio-mass energy, energy conversions, application of energy transfer.*

INTRODUCTION

Energy conversion systems are advanced if they improve upon conventional ones. The improvements may be in one or several categories: higher energy and/or energy efficiency, lower energy and/or species emissions, lower capital cost, lower operating costs or required expertise and higher reliability. Obviously, improvements in some categories should not cause unacceptable. deterioration in others, and synergistic improvements where an improvement in one category results also in improvements in other categories are the most desirable. For example, increasing efficiency also reduces energy emissions to the environment. This paper reviews some leading novel energy conversion approaches which are aimed at improving power generation efficiency and/or reducing harmful emissions, in large part based on work by the author and his co-workers. Some of the concepts used for cycle improvement are higher top temperatures, improved combustion systems, evasion of the Carnot limit by integration with fuel cells and direct nuclear energy conversion to power (the nuclear generator), reduction of energy destruction by staging and the use of energy-efficient combustion processes, the use of lower temperature heat sinks and the use of renewable, environmentally-benign energy sources.

Objectives

1. To study energy transmission of bio heat energy transfer.
2. To study the conversional applications of energy sources.
3. To study the heat to power energy to electrical energy.

Scope

Conventional power generation processes are accompanied by the emission of species into the environment, with associated detrimental effects. Such emissions occur during the fuel extraction, transportation and conversion phases and may produce secondary emissions of their own as they deposit in the environment or are stored somewhere. They consist of a variety of species, ranging from radioactive materials, some of which, such as plutonium, have half-lives of tens of thousands of years, hydrocarbon, inorganic and inert gases, liquid hydrocarbons and solutes in water (such as coal mine drainage), and various combustion products. Prevalent among the latter is CO2, which until recently was thought to be harmless and has then been found to have major effect on global warming. Perhaps one of the least harmful emissions is that of water vapour, which the primary emission is when H_2 is used as the fuel. Even though some researchers are gone through this the elaborate study needed to optimise the techniques.

Energy conversion energy emissions

Any of the energy input into a power generation system, which does not get converted into useful work ends up as heat, which in a steady-state process is discarded into the environment if unused. It is consequently important to note that high efficiency is not only rewarding from the power output standpoint, but it also reduces the thermal burden on the environment. Although such energy emissions mostly end up ultimately as heat, they in many cases have other environmentally detrimental effects during their transformation into heat. For example, although constituting only a small fraction of the discarded energy, radioactive emissions from nuclear power plants, such as neutrons and particles rays, as well as strong electric fields emitted by electrical power generation and transmission equipment, may cause harm significantly beyond their energy content.

Methods

RAISING THE TOP TEMPERATURE

Most energy sources are not in principle limited by the temperature to which they can elevate the working fluid of the power generation cycle. This is operationally obvious in fuel combustion systems and nuclear fission or fusion systems, but is even true for diffuse sources such as solar energy: temperatures of thousands of degrees have already been attained with existing concentrators. Increasing the efficiency of thermal power generation cycles by raising the top temperature is, thus, not constrained by the potential of the energy source to do so, but is constrained by the ability of engineering materials and devices to withstand higher temperatures, sometimes accompanied also by higher pressure and other effects detrimental to the ability of the device to perform its function. Much progress has been made during the past century in raising the top temperature of the working fluids. This was achieved by a combination of better materials and more ingenious device engineering, such as turbine blade cooling, intermittent combustion accompanied by cooling in internal combustion engines and magnetic field confinement of plasmas at temperatures of millions degrees in fusion power experiments. Here we give an example of a proposed power cycle in which higher top temperature can be achieved by incorporation of a device which can tolerate such temperatures because it has no moving parts, is not subjected to high pressures and can thus be constructed from available materials such as graphite, graphite composites or ceramics.

Improving low temperature cycle efficiency by high-temperature superheat

There often exist situations where the top cycle temperature is well below the tolerance limit of conventional materials and devices. Some of the examples are solar power systems which use flat-plate or moderator-concentrating collectors, geothermal systems, waste-heat operated systems and water-cooled nuclear reactors where the limitation is due to the accompanying steam pressure and the combined pressure and temperature effects on fuel-rod integrity.

Lowering the bottom temperature

Thermal power plant efficiency increases as the bottom temperature is lowered. In the temperature range of ambient coolants, an efficiency improvement of up to about 1/2% is obtained from each °C by which Tc is lowered. It is thus desirable to seek ways to do so and a few are described below. One well-trodden path is the improvement of heat transfer in the heat rejection equipment, most prominently in the power plant condenser. This lowers the condensation temperature and pressure of the steam by bringing its temperature closer to that of the coolant. At the same time this approach increases capital costs and pumping energy use. A most intuitively obvious way to that end is the finding and use of colder coolants. Since power station location is presently dictated in large part by the need for some proximity to the users and by environmental constraints, the selection flexibility as well as the existing differences between the available conventional coolant sources are rather small. At the same time there potentially exist at least three low temperature heat sinks for thermal power plants which deserve consideration: the cold water in the depths of the oceans throughout the world, the cold air, water and ice in the polar regions, and space. There are many locations around the world, even near the equator, where ocean water temperatures are down to about 5°C at depths below about 500 m. After considering pumping losses, the use of this water for cooling the power plant condenser is expected to raise the plant efficiency by at least 10%. Several experiments of ocean-thermal energy conversion (OTEC) have demonstrated that the construction of the piping system to these depths, and the pumping of the cold water to the surface, are feasible and within reasonable cost.

Cleaner combustion

Many methods are being pursued to obtain combustion which produces lower emissions, especially of the species more hazardous to health. Described here are two approaches in which the author and his co-workers are engaged.

The radio actively-conductively stabilized combustor (RCSC) In most combustion devices the energy necessary to heat the fuel to the point of ignition is supplied by back-mixing either by molecular or turbulent diffusion. The back-mixing produces an extended reaction zone, contact between the fuel-air mixture and the products of combustion and oscillations. These three side-effects are known to enhance NOx formation.

When the fuel was pulverized coal, the flame zone was found to be thicker than with fluid fuels, but thin, from about 30 cm near the wails to about 50 cm at the center, relative to conventional pulverized coal combustors. Coal residence times were thus only 0.125 to 0.6 s, smaller than the residence times of about 1 s in commercial combustors using recirculation for flame stabilization, even though the RCSC analyzed here had gas velocities which are about two orders of magnitude slower than those in such commercial combustors. This has the promise of significant reduction in NOx production.

Solar and lunar energy

Solar radiation can be used for direct conversion to electricity, using photo voltaic cells, for thermal plant power generation by converting it into heat, or by its catalytic effect in various photochemical reactions, such as photosynthesis, with subsequent conversion of the biomass to heat. The solar energy input to earth also gives rise to other effects which can be exploited for power generation, such as wind, ocean currents and the ocean temperature differences. The moon produces tides and contributes to wave formation, allowing the use of tidal and wave energy. In the context of advanced energy conversion, the solar and lunar sources excel particularly in two areas: they are practically inexhaustible, produce minimal species emissions and do not alter the global heat balance. Unless used in thermal power cycles or as combustion fuels, they also have minimal local thermal emissions.

Probably the most rapid progress in solar energy conversion technology is seen in photo voltaic, where single cell efficiencies have exceeded 30% in the laboratory. These numbers are approaching power generation efficiencies in conventional nuclear power plants. Improved efficiency, reduced cost and better long-term stability of the cells are the primary objectives of R & D in that field. Solar thermal power generation was already proven under certain economic circumstances to be commercially competitive in small fuel-superheated plants.

RESULTS OF THE STUDY

While the continuing improvements in conventional power generation technology should not stop, the 21st century should see much more devotion to unconventional frontier approaches to that problem, obviously with proper attention to the accompanying economic and societal issues. The development of new economical materials and devices would allow design of thermal power plants for operation at higher temperatures and efficiencies, but emphasis should be placed on direct energy conversion, i.e. energy-efficient processes which are neither Carnot-limited nor accompanied by large thermal and species emissions. Among these processes, some of the most appealing at present are direct conversion of solar radiation to electricity, and fuel cells. Devices for these are rapidly declining in price, headed for competitiveness with other power generation schemes and are increasingly used in appropriate commercial applications. Direct conversion of fission and fusion energy into electrical or mechanical power deserves much attention, especially if the nuclear waste problem is resolved in a definitively satisfactory manner. The use of space for power generation seems to be inevitable: it provides the best heat sink and relieves the earth from the penalties of power generation. Both the costs of launching payloads into space and those of energy transmission are declining. In the interim, more efficient production of power from low temperature sources, such as solar and waste heat, co-generation, low-emission combustion systems, exploration of hydrogen as fuel and significantly safer nuclear power production must be pursued.

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