

Review on the Thermo-Electric Power Generation

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Abstract – The Thermoelectric power generation technology provides attractive alternative generation potential to the electric power utilities. In this paper on Thermoelectric technology an outline of the technology and its future in the energy reserves is covered. This paper also discusses the recent developments taking place in thermoelectric effect power generation in India.

Keywords: - Thermoelectric effect; Thermoemf; Seebeck Effect

I. INTRODUCTION

Due to the decreasing availability and increasing cost of natural gas and fuel oil (conventional energy sources), non conventional energy sources are likely to play an important role in nations energy scenes. Non Conventional energy sources includes Solar, Mhd, Wind, Tidal etc. One of these non conventional sources of energy include power generation by Thermoelectric effect

II. PRINCIPLE OF OPERATION OF THERMO-ELECTRIC EFFECT

The principle of thermo-electric effect can be discussed in the form that it is a device which converts heat energy into electrical energy through semi-conductor or conductor [1]. If two dissimilar materials are joined together in the form of a loop having two junctions. And a temperature difference is maintained between the two junctions, electric current would start to flow around the loop due to movement of electrons due to density difference and temperature difference maintained. The magnitude of the current will depend on both the materials used and the temperature difference of the junction ($\Delta T = T_2 - T_1$). If the circuit is broken an open circuit voltage V appears across the terminals of the break.

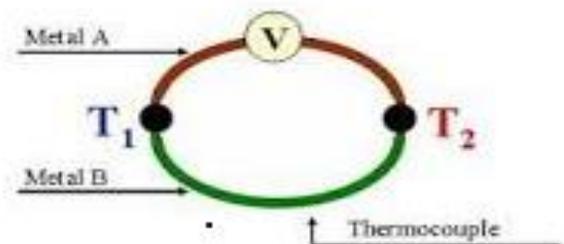


Fig.1. Thermo-electric effect (Basic Principle)

The Seebeck coefficient depends upon the choice of the materials and can not be attributed to either material above. It has unit of volt per degree. Depending upon the choice of materials, the drop in the potential may be either positive or negative in the direction of the drop of temperature. Thus the sign as well as magnitude of the Seebeck coefficient is significant. If seen closely, the Seebeck effect arises because the concentration of the charge carriers in a conductor depends upon the temperature. The Seebeck effect is a classic example of an electromotive force (emf) and leads to measurable currents or voltages in the same way as any other emf. Electromotive forces modify Ohm's law by generating currents even in the absence of voltage differences (or vice versa) [2]

III. PRODUCTION OF A THERMO EMF

The presence of a temperature gradient in a material causes a carrier concentration gradient and an electric field is established, which causes the net flow of charge carriers under

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open circuit conditions to be zero. By placing the hot junction at the point where a knowledge of temperature is required, and maintaining the other at known fixed temperature, the output open circuit voltage, or the circulating current produced, is then proportional to the temperature.

A qualitative idea of this phenomenon is as follows. The materials of which the loop illustrated is constructed contain certain densities of free electrons. When the two materials are placed in contact, the free electron will diffuse throughout them. In general the materials will first contain different densities of free electrons [3]. The result will be that to reach equilibrium electrons will have to diffuse from the regions of high density to those of low density. Consider fig. material 2 has a higher density of free electrons than material 1 and also $T_2 = T_1$. When the materials are in contact, the free electrons of the electron gas will diffuse to equate the density throughout the region. As the density was originally greater in material 2, electrons will leave this material, so that it becomes positively charged, and will enter material 1, thus charging it negatively. As more electrons flow across, the potentials will increase [4]. Eventually an electric field build up across, the the junction just sufficient to oppose the net diffusion of any further electrons.

The differential diffusion results in the appearance of a potential difference across the junction; which is known as the contact potential [5]. In the loop of fig. Considering the junction to be at the same temperature, each will develop a contact

shown is raised in temperature resulting in greater increase of electrons in material 2 than in material 1. To maintain equilibrium more electrons will have to leave material 2 than previously, resulting in an increased contact potential [6]. As the other junction has been kept at the same temperature its contact potential has remained the same. The result of increasing the temperature at one junction is thus to produce an imbalance of contact potentials [7]. The difference produces a resulting emf that will derive a current round the closed loop.

IV. ADVANTAGES OF THERMO-ELECTRIC EFFECT

Seeing the receding fuel level, Non Conventional Sources of energy like Thermoelectric effect plays a vital role to fulfill the growing power needs of the society [8]. With population growing or we can say power consumers growing alternative sources of energy like these would play a pivotal role in fulfilling the same. This source of energy being less polluting and since it uses or thrives on waste heat of a system this type of energy source can be used in various industries where waste heat can be utilized to tap energy [9].

V. THERMOELECTRIC EFFECT PROGRAMS IN INDIA

India has vast reserves of coal and derives most of its energy needs in the form of thermoelectric power plants in the nation. This technology is being utilized in the waste heat section of these power plants where the waste heat is tapped by the thermocouple hence the losses are also minimized along with the conversion of lost heat into useful power.

VI. CONCLUSION

Thermoelectric power like MHD, Solar power, Tidal, Geothermal are all the future energy reserves and would definitely fulfill the energy needs of the future generations. Since today desperate attempts are being made to look for pollution free energy sources, these type of sources are definitely the future defining and sources to reckon with in both the developing and developed countries of the world

VI. REFERENCES

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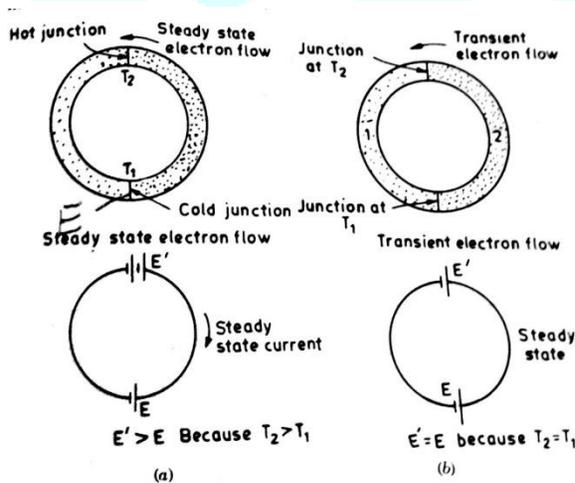


Fig-Production of a Thermo Emf

potential in equilibrium these are equal and opposite, so that there is no net current round the loop. If the temperature is increased but the incremental increase in one material will be greater than in other. Consider that one junction of the couple

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