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New Design for Charging Section of Electrostatic Precipitators Using Thermocouple Principle for Air Pollution Control

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Abstract: Classical designs for electrostatic precipitators in industries use high voltage current. A new design is proposed for charging sections by using properties of materials used for thermocouples. This design uses materials which are being used for thermocouples in constructing champers of electrostatic precipitators. This design does not require high voltage current.

Keywords: Thermocouple, Electrostatic Precipitator, Air pollution control

INTRODUCTION

Some industries have to let polluted air with dust particles as well as chemical particles in our atmosphere. To keep our environment clean, our atmosphere should be protected [16]. So, there is a need to extract dust particles from polluted air in industries before the polluted air is sent into our atmosphere. Meshes may be used to catch big size particles in the polluted air. To get small size particles from the polluted air, there is a most promising method of using electric fields. Classical electrostatic precipitators work on the principle of creating electrostatic fields, charging and attracting dust particles by using opposite electrostatic fields and then removing attracted dust particles. To create electrostatic fields in electrostatic precipitators, coronas are created by means of high voltage current [1] at least having voltage 10 KV, normally with voltage 100 KV. The electric instruments (like switches) should be used to manage high voltage currents in electrostatic precipitators for charging sections. It is possible to design charging section in a new type of electrostatic precipitators, just using current only with normal voltage or current meant for houses or very small industries. This possibility is explained in this article. This possibility is based on Seebeck effect for thermocouples [2]. The main advantage of using the new design proposed in this article is the following. One need not handle high voltage current for electrostatic precipitators. The second section presents a design for classical electrostatic precipitators. The third section presents an explanation for Seebeck effect in thermocouples. The fourth section presents a new design for electrostatic precipitators which can be used even for diesel/gas/petrol vehicles.

CLASSICAL ELECTROSTATIC PRECIPITATORS

The charging section of an electrostatic precipitator has an anode section and a cathode section [3] and material can be used for anode section is graphene [4, 5] and for cathode section will be many elements [6]. The metal cylinder for anode section is connected with a source for high voltage positive charges. See Figure 1.

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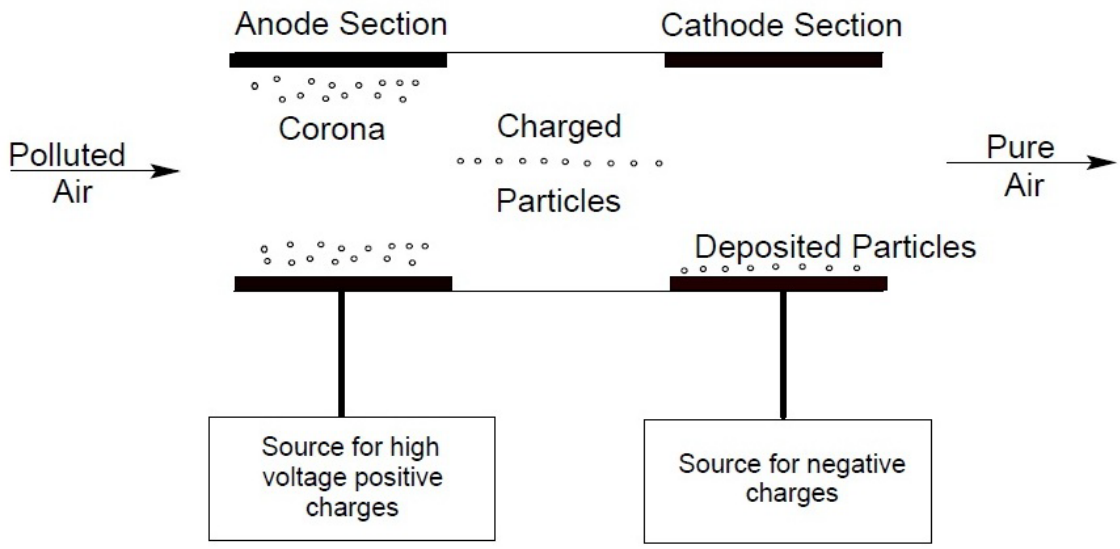

Figure 1. Classical Electrostatic Precipitator

The metal cylinder for cathode section is connected with a source for negative charges. A corona is created in the anode section because of high voltage. Polluted air is sent through the anode section and the dust particles receive positive charges. Then air with positively charged particles move continuously and reaches the cathode section which is connected with a source for negative charges. The positively charged particles are attracted by the cathode section, and they are deposited in that section, because the cathode section is connected with a source for negative charges. Another mechanism should be used to remove the deposited charge particles [7].

SEEBECK EFFECT

A thermocouple consists of two wires joined at two ends. One wire is made up of a material which is ready to donate electrons when it is heated. Let us call it a donor material. For example [8, 10-15], iron is a donor material. A donor material reverses its nature when it is cooled. That is, a donor material is ready to receive electrons when it is cooled. Another wire is made up of a material which is ready to receive electrons when it is cooled. For example, copper is an acceptor material. An acceptor reverses its nature when it is cooled. That is, an acceptor is ready to donate electrons when it is cooled. If one joint end of a thermocouple is kept in a hot place and another joint end is kept in a cool place, then the electrons move in the direction mentioned in the Figure 3.1 and a current is produced. It is possible to apply this electron movement principle in designing a new electrostatic precipitator.

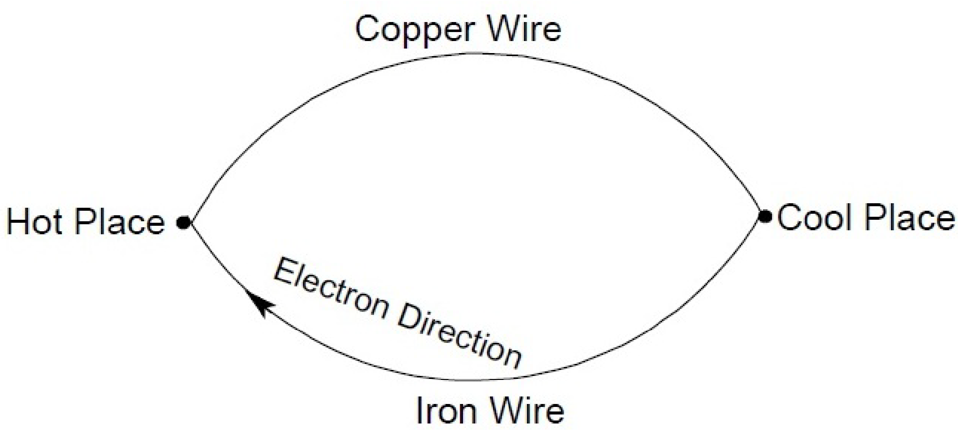

Figure 2. Thermocouple

NEW DESIGN

Again, there are two sections, namely, anode section and cathode section. They are connected to a direct current source as given in the Figure 4.1. Cathode section cylinder is made up of a donor-material and anode section cylinder is also made up of a donor-material. To create a corona inside the cathode section cylinder, this cylinder is heated, by means of a heated fluid through a tube or by means of an electric-resistor coil. In the other section, to increase attracting capacity to attract negatively charged dust particles by anode section, the anode section cylinder can be cooled by means of cooled fluids through a tube (This cooling part may be omitted for two-wheeler vehicles).

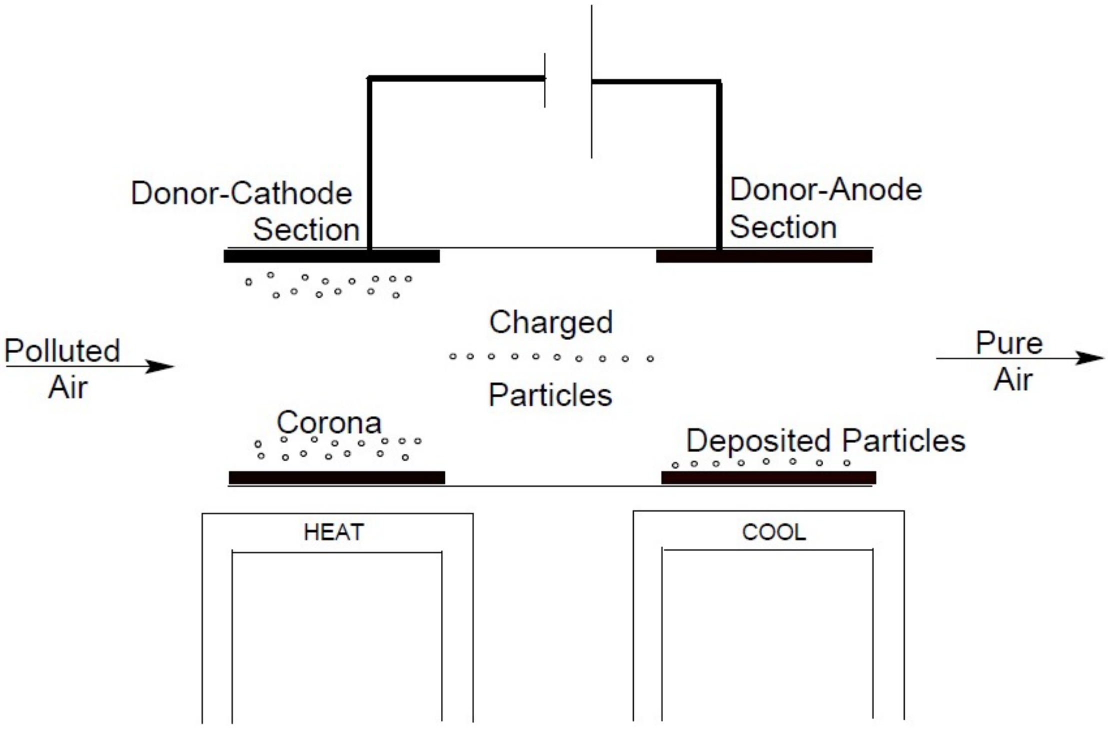

Figure 3. New Electrostatic Precipitator

Let us observe that creation of corona in cathode section and increase of attracting capacity in the anode section are based on the properties of donor materials used for thermocouples as explained in the section for Seebeck effect. If the polluted air entering into cathode section is already hot, then corona may not exist. To avoid this problem, hot polluted air should undergo a cooling process before it get through cathode section, or the cathode section should be heated with a heat more than the heat of the air [9].

One can use an acceptor-material for anode section and for cathode section simultaneously, but in this case the cylinder in cathode section should be cooled instead of heating the cylinder and the cylinder in anode section should be heated instead of cooling, in view of the properties of acceptor-materials. There is no guarantee that energy could be saved in the new design, and there may be a need to use a medium ampere current. But high voltage is not needed for current.

CONCLUSIONS

A material having thermocouple properties can be used in selecting materials for charging sections in electrostatic precipitators. The new design proposed by means of thermocouple properties is helpful in avoiding equipments for handling high voltage currents in electrostatic precipitators. Thus, it will be a promising modelling of electrostatic precipitator to control air pollution.

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