CHAPTER ONE

INTRODUCTION

1.1 Background

The deterioration of the environmental quality, which began when man first collected into villages and utilized fire, is a serious problem given the increasing impacts of the rising population and industrialized society. Contamination of air, soil, water and food threatens the continue existence of many plant and animal communities in the ecosystem and may ultimately threaten the very survival of human race. Industrialization has always been a double-edged sword, which, while provided material and social benefits has brought in it's wake equally big material and social problem. The most serious among these is environmental pollution.

The higher the energy consumption, higher will be the pollutants released into environment. In terms of volume and variant of contaminants emitted, on other side industry comes close to matching the negative impact from electric power plant. In 2003 coal – fired power plants accounted for 51 percent of all electricity generation in the USA [1]. They are responsible for 80 -99 percent of pollution from the electric power industry making the number one source of air pollution.This pollution causes premature death, acid rain, ozone-smog, global warming, deadly particulate matter and other toxic contamination of our eco-system.

Scientific studies have suggested links between particulate matter and numerous respiratory heath problems including asthma, bronchitis, and premature deaths. These fine particles are also a major cause of visibility impairment as per estimates have reduced the visual rang of natural conditions by 70% in some part of the U.S [2]. Air pollution control devices can represent a major portion of

investment in an industrial plant, mainly in coal-based power plant. Their relatively high cost and the nature of particulate matter to be reduced in coal fired plant mandate extreme caution in the proper selection of control equipment.

There are different methods to capture varied particulate matter. As particles become smaller, specifically less than 1 micrometer in diameter, gravitational and centrifugal forces become less powerful, while electrical and to a lesser degree. Consequently, electrical collection is an effective method for separating those sub – micron particles from the gas steam. Most importantly, whereas mechanical collector exert their force upon the entire gas. ESP's exert their force only upon the particles to be collected. ESP's typically operate at around 0.5- 0.1 inch pressure drop, regardless of air volume or particle size [3].

Electrostatic precipitators are the most common industrial devices for particular control. These devices are estimated to have 70% of the total market because they are used in wide ranges of gas temperatures, typically from 250 F to 750F. Efficiency levels from certain ESP's in removing most particulates from stream are as high as 99% on mass basis [5]. ESP's are durable, cost effective, and relatively easy to operate. One of the most important uses of ESPs in today's context is the collection of the large quantity of fly ash produced in the low quality coal-fired power station. Lower quality of coal produces higher percentage of fly ash, which is incombustible material. Ohio generates nearly 6$ billion annually from the mining, processing, and combustion of coal to produce electricity and employ 37000 people annual. Since, Ohio is a leader have the potential to severely impact the economy of Ohio state. The proposed research will not only make it possible to use the coal extensively and efficiently under the proposed regulation, but also will increase the revenue of the entire state [4].

1.2 Problem Statement

Electric filters are employed in variety of technologies such as ore smelting, steel production, pulp and paper manufacturing, fossil-fuel power generation, cement production, chemical processing and domestic air cleaning. In industrial countries, standards were adopted to impose some control over the emission for dark smoke into the atmosphere and, hence, to reduce atmospheric pollution. Electrostatic precipitation is an efficient method of cleaning industrial gases from suspended particles.

1.3 Objectives

Dry ESPs are used in industry since 1990. The main objective of this research focusing on increase and improving the collection efficiency of dry ESP in capturing particulate matter namely fly ash. Also this research is to found the relation of collection efficiency as a function of voltage and then use data in Garri4 power plant ESP behavior, to predict the voltage required for higher efficiency.

1.4 Methodology

This thesis is aimed at calculating the collection efficiency of ESP using MATLAB code to simulate the mathematical model of ESP. At first, the electric field is calculated in the vicinity of the discharge wire. Second, the pressure distribution around the discharge wire due to gas flow is assessed. Third, the onset voltage of corona on the discharge wire is calculated based on the criterion of the recurrence of negative charges. This calls for field calculation and pressure assessment around the discharge wire as per-requisites. Finally, calculating the collection efficiency of ESP and the impact of variation of voltage and the other parameters on collection efficiency.

1.5 Thesis Layout

In chapter two, a literature review of electrostatic precipitator is given in detail. The mathematical model is discussed in chapter three. Chapter four presents the results, conclusion and recommendations are presented in chapter five.