CHAPTER 1

INTRODUCTION

1.1 Introduction

SF_6 has been widely used as insulation media for gas insulated switchgear (GIS) and gas insulated transmission line (GIL), due to its excellent insulation and arc quenching properties. Although the SF_6 gas has superior dielectric properties, SF_6 gas made an issue of environmental influence due to its high global warming potential (GWP=23900). Thus the development of an alternative gas or gas mixtures having much lower GWP is strongly required. Mixtures composed of a strongly electronegative gas of high dielectric strength such as SF_6 and an ordinary gas (N_2, CO_2 or air) are used.

The presence of contaminating particles lowered the dielectric strength of the gas mixtures sharply. Many studies were carried out both Theoretically [1-6] and experimentally [7-11] to determine the role of single contaminating particles in initiating breakdown in gaseous insulation. This work considered a multi-particle contamination in the gas mixture which is very limited in the published researches. The determination of the breakdown voltage in the gas requires the knowledge of the potential and field distribution on and around the charged particle

surface. So in this thesis, the electric potential and field distribution are studied between two parallel plates with a various shapes of contaminating particles such as wire-shaped (filamentary) particles and spherical particles when it rested on the earthed plate and hovering in the gap. Also, the electric potential and field distribution on and around multi-particles are studied. The finite element method [FEM] has been used throughout the calculations in this work, for its favorable accuracy, when applied to high voltage problems.

1.2 Objectives of the Thesis

This work presented the electric potential and field distributions around the contaminating particles and the breakdown voltage calculations on and around wire and spherical contaminating particles between two parallel plates inside compressed gas devices.

This work aims to:

1. Evaluating the electric potential and field distributions on and around wire contaminating particle rested on the earthed plate. The effect of particle dimensions and gap spacing on the electric field values will be studied.
2. Evaluating the electric potential and field distributions on and around Wire contaminating particle hovering inside the gap. The effect of

particle height above the ground plate on the electric field values will be presented.

3. Evaluating the electric potential and field distributions on and around Spherical contaminating particle rested on the earthed plate. The effect of particle radius on the electric field values will be presented.
4. Evaluating the electric potential and field distributions on and around Spherical contaminating particle which hovering inside the gap. The effect of particle height above the ground plate on the electric field values will be presented.
5. Evaluating the breakdown voltage with the presence of particle contamination. The effect of gas pressure, the particle dimensions and the gap spacing between two parallel plates on the breakdown voltage will be presented.
6. Evaluating the electric potential and field distributions on and around multi-particles. The effect of the spacing between hovering and rested on earthed plate particles on the electric field values will be presented.
7. Evaluating the breakdown voltage around multi-particles. The effect of gas pressure and the spacing between the particles on the breakdown voltage will be presented.

1.3 Thesis Outline

To achieve the above objectives, this thesis includes six chapters.

These chapters are presented briefly as the following:

CHAPTER (1): INTRODUCTION

This chapter presents an introduction for the main objectives of thesis and thesis outline.

CHAPTER (2): LITERATURE REVIEW

This chapter presents numerical methods for electric field calculations with the discussion of methodology of finite element method and importance of using GIS compared with AIS. Also it presents the advantages and disadvantages of SF_6 gas and the using of SF_6 gas mixture as alternative to pure SF_6 gas. The chapter presents the previous works which achieved by other researchers.

CHAPTER (3): Electric Field Distribution Around Contaminating Particles Between Two Parallel Plates Inside Compressed gas devices

This chapter presents the results of electric potential and field distributions on and around wire and spherical contaminating particles when rested on the earthed plate and hovering in the gap inside compressed gas devices.Also,it presents the effect of particle dimensions; it's height from ground plate and gap spacing on the electric field values.

CHAPTER (4): Breakdown Voltage Calculations For Parallel Plates and Gap with Particle Contamination Inside Compressed Gas Devices

This chapter presents the results of breakdown voltage for parallel gaps and gap with particle contamination. Also, it presents the effect of gas pressure, particle dimensions and gap spacing on the breakdown voltage.

CHAPTER (5): Electric Field and Breakdown Voltage Calculations for Multi-Particles Contamination

This chapter presents the potential and field distributions on and around multi-particles. It introduces the effect of the height and the spacing between particles on the electric field values. Also, it presents the breakdown voltage around multi-particles and the effect of gas pressure, height and the spacing between particles on the breakdown voltage.

CHAPTER (6): CONCLUSIONS

Enumerates the major conclusions of this work.

REFERENCES

Display the references used through this thesis.