

CHAPTER 2

Objective & Justification of the Research

Work

This chapter presents the objective of the research, importance, and justification of the work done.

2.1 Introduction

The coal mining industry is facing many challenges under the current socially and environmentally owned scenario. Environmental issues, monitoring, and management are significant issues and are an integral part of mining operations. Among various aspects, productivity, healthy environment, mining professionals' health, and project-affected people are an important component. The mining industry faces various environmental issues like land pollution, water pollution, deforestation, air pollution & socio-cultural issues. Air quality deterioration due to opencast coal mining is also need to be addressed thoroughly. There is an emission of particulate matter from coal and associated rocks during various mining operations. Due to coal occurrence, various coal-based industries also developed in such coal mines and responsible for deterioration of the area's air quality. In this research work, the status of particulate matter of different sizes along with NO₂ and SO₂ concentrations in the ambient air has been done. The chemical characterization of particulate matter, source contribution and health associated study have also been done. For this investigation, selected representative sites are monitored throughout the year to assess the effects of nearby activities on air quality. Continuously under laboratory investigation, the study has been carried out to characterize the particulate matter produced

in the field in terms of concentration, size, and composition. For the management of particulate matter, a laboratory–scale model has been designed and fabricated to make the existing plane water spraying method more effective.

Keeping in mind the threat poses by opencast mining and thermal power plants, a detailed air quality study has been carried out in the study area.

The elemental characterization and source apportionment of the particulate matter in and around the Singrauli coalfield has been done for two consecutive years.

2.2 Objectives of the research work

It has been observed through a literature survey that the characterization of particulate matter in ambient air plays a crucial role in deciding the virulency of particulate matter as far as impact on air quality is concerned. Air quality, particularly in opencast mines, is important not only for mine workers and professionals but also for the nearby population. There is a continuous addition of activities and an increase in production year after year in the area. Keeping in view the importance and need for air quality status of this area, the objective of this study was as follows:

- 1) to assess air quality status in and around coal mining complex and thermal power plants,
- 2) to assess the variation in concentration of particulate matter of various sizes along with nitrogen dioxide and sulphur dioxide,
- 3) chemical characterization of particulate matter of various sizes in terms of major, trace, and radioactive elements,
- 4) determination of health risk assessment in and around the mining complex,

- 5) to quantify the contribution of various sources of particulate matter for air quality deterioration, and
- 6) mitigation of particulate matter.

2.3 Justification of the research work

The increase in the concentration of air pollutants and side by side control measures for suppression of particulate matter in air requires thorough monitoring of air quality in the area. The air quality data generated here by the National Ambient Air Quality Management Program (NAMP) showed that the particle's concentration level is gradually increasing and crossing the permissible limit, especially in the mining sector.

Monitoring and evaluation of ambient air quality is the first important step in controlling pollution. There are many sources of SPM in the area due to the presence of various industries. The monitoring of particulate matter is a statutory requirement for all types of mines. The monitoring of particulate matter only at a specific location represents the area's actual air quality conditions due to a sufficient number of sampling in the area and meteorological factors.

The use of chemical techniques and statistical techniques probably helps in identifying various sources in the study area. Besides, coal mine particulate matter contains many ingredients that have a dangerous effect on human health. Therefore, it is necessary to estimate the cumulative impact.

The study of particulate matter monitoring, source contribution, and chemical characterization are becoming essential for air quality management.

The concentration of particulate matter in and around opencast coal mines and coal-based thermal power plants are a significant issue because of the following affects:

- 1) the particulate matter affects the health of professionals and the adjoining population,
- 2) generation of dust decreases the life of machinery & increases the maintenance of equipment,
- 3) the particulate matter affects visibility, and
- 4) decreases the growth of vegetables because of the reduced availability of sunlight.

Overall, it affects residents' quality of life in general and mine professionals in particular around the mining complex.

2.4 Plan of the research work

The representative sites were selected in mining and residential area for air quality monitoring in terms of concentration and size. All the laboratory investigation, other work and interpretation has been done here. However, the chemical characterization of particulate matter was done at the Radioanalytical Laboratory of Health Physics Division of Bhabha Atomic Research Centre, Mumbai.

The whole work may be divided into four parts:

- 1) In the first part, different particulate matter sizes along with NO₂ and SO₂ have collected, and air samplers measured their concentrations.
- 2) In the second part, collected filter papers were processed and analyzed for chemical characterization using relevant analytical tools and methods.
- 3) In the third part, source apportionment study and human health study were carried out.
- 4) In the fourth part, the control method has been suggested to suppress the particulate matter.

The whole thesis com comprises of eleven chapters as follows:

Chapter 1 – Introduction & literature review

This chapter explains the detailed work done by other researchers on particulate matter covering all aspects of dust along with source identification and apportionment techniques. The research gap and the relevance of the study are also explained.

Chapter 2 – Objective & justification of the research work

This chapter presents the introduction, objective, justification, and plan of the research work.

Chapter 3 – Description of Study Area and Experimental Details

This chapter discusses, in brief, the study area and detailed laboratory methodology analytical techniques.

Chapter 4 – Monitoring of Ambient Air Quality with reference Speciation and Concentration

This chapter describes the particulate matter of different sizes and nitrogen and sulphur dioxide in terms of concentration, spatial and temporal variation, seasonal variation in concentration, and monthly average variation in the area at a different location.

Chapter 5 – Characterization of particulate matter with reference to composition

This chapter discusses the importance of the elemental composition of different sizes of particulate matter. A sequential extraction procedure was applied for the speciation of water-soluble inorganic ions, major and trace elements (Ag, Al, As, Br, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Na, Ni, Pb, Se, Si, Sr, Th, U, V, Zn, C, H, N, S, Br⁻, Cl⁻, F⁻, NO₂⁻, NO₃⁻, PO₄³⁻, SO₄²⁻, Ca²⁺, K⁺, Mg²⁺, Na⁺, and NH₄⁺) in airborne particulate matters of different sizes.

The water-soluble inorganic ions and major & trace elements concentrations have been investigated and discussed. The enrichment factor and correlation studies have also been discussed.

Chapter 6 – Characterization of particulate matter with reference to natural radioactivity

The activity concentration of isotopic potassium (⁴⁰K), lead (²¹⁰Pb), thorium (²³²Th), and uranium (²³⁴, ²³⁵, and ²³⁸U) of the atmospheric particulate matter in various sizes in the Singrauli coalfield has been investigated and discussed in this chapter.

Chapter 7 – Characterization of particulate matter with reference to gross alpha and gross beta activity

This chapter presents the activity concentrations of gross alpha and gross beta in different sizes of particulate matter of the Singrauli coalfield. Various aspects of activity concentration have been investigated and discussed, along with the annual effective dose.

Chapter 8 – Human health risk assessment due to inhalation of particulate matter

This chapter describes human health risk assessment of exposure to particulate matter by inhalation.

Chapter 9 – Source identification and apportionment

This chapter discusses receptor modeling for source identification and apportionment.

Chapter 10 – Management of particulate matter

This chapter briefly discusses the experiment done for management of particulate matter.

Chapter 11 – Conclusions & future work

Conclusions provide the finding drawn from the field and laboratory investigation are given in this chapter along with brief scope of future work.

In the end, a list of references has been added, and the published work is included at the end of the thesis.

The flow diagram of the methodology of the research work done is shown in **Fig. 2.1**.

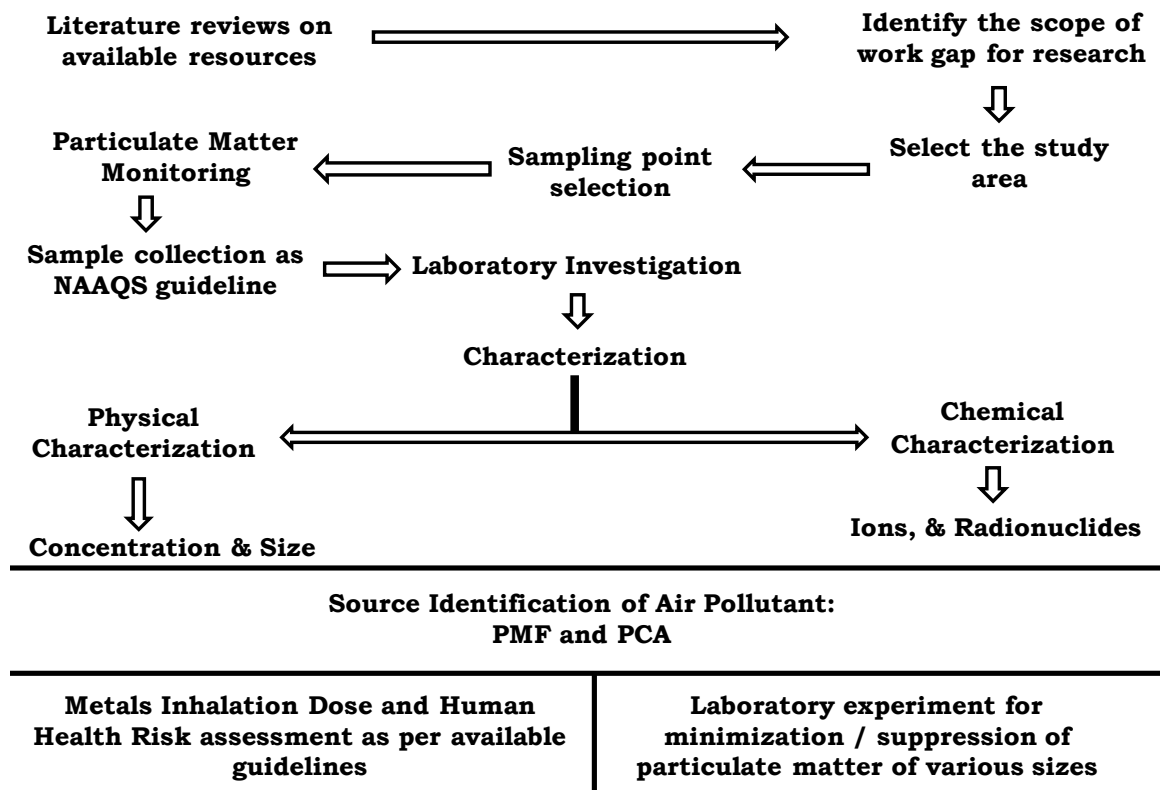


Fig. 2.1: Flow diagram of the methodology of the research work