CHAPTER 8

SUMMARY AND CONCLUSION

8.1  INTRODUCTION

Pollution is an undesirable change in physical, chemical and biological characteristics of air, water or soil that may be harmful to human and other lives. Human and other activities generate enormous amounts of waste materials. Such materials are disposed through various methods amounting to components of environmental pollution.

The rapid pace of industrialization has made soil ecosystem one of the worst-hit victims. It is time to recognize that the economic and social development depends on the protection of the environment and healthy living. Environmental problems like soil contaminations pose major threats to life safety and health of all living beings and productivity. The need to take actions to sustain soil is pressing and challenging. There is a growing necessity for the pollution monitoring mechanism and hence, for the methods to assist as diagnostic tools for determining the degree of pollution.

8.2  ANALYTICAL METHODS

In order to investigate the extent of soil pollution, the following spectral, elemental, thermal and Physico-chemical studies were successfully carried out. They are FT-IR, XRD, WD-XRF, SEM-EDX, Thermal analysis and Physico-chemical analysis.
The following conclusions are arrived at after involving the polluted soils from industrial area at Karaikal, Puducherry State, India in the analyses. The findings are given in the same sequence in which they have been discussed in the preceding Chapters.

8.2.1 Findings through Physico-Chemical Analysis

- Physico-chemical parameters such as pH, electrical conductivity, organic carbon (OC), total hardness (TH), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), iron (Fe), copper (Cu) and zinc (Zn) were measured.

- There were large variations of soil chemical and physical properties across the soil of different sites.

- Soil physical properties were mutually independent as per the correlations. The random behavior may be attributed with the soil contamination in this area.

8.2.2 Findings through XRF Method

- XRF analysis estimated elemental concentrations in soil samples of various sites. Elemental variation in soils of different canals and sites are brought out.

- WD-XRF identified elements such as aluminium, calcium, chlorine, copper, iron, potassium, magnesium, sodium, lead, silicon, titanium and zinc in quantitative aspects.

- Presence of elements such as aluminium, copper, silicon lead and titanium in higher concentration in soils is demonstrated and concentrations are compared with standard values.
• Furthermore, calibration matrices revealed that the distribution of elements is random.

8.2.3 Findings through FT-IR Method

• FT-IR method is a powerful technique for mineral analysis in geological samples.

• The study reveals that kaolinite and quartz minerals were predominant whereas montmorillonite and hematite are in moderate levels and organic materials are found in trace.

• Quantitative analyses of soils brought out constituent minerals with respective fraction as quartz (36%), kaolinite (34%), hematite (13%), montmorillonite (12%), illite (3%) and organic material (2%).

• Furthermore, for the binary mixtures of soil compositions like, illite/kaolinite, illite/quartz, illite/hematite, kaolinite/quartz, kaolinite/hematite and Quartz/hematite, calibration equations were performed.

8.2.4 Findings through XRD Method

• Powder X-ray diffraction is used for analyzing both chemical and mineralogical composition of the clay materials qualitatively.

• The soil samples from different locations of the industrial area indicate the presence of quartz, kaolinite, hematite, calcite, aragonite, feldspar and illite with hexagonal, anorthic, rhombohedral, orthorhombic, anorthic and monoclinic crystal structure respectively.
• Among the various minerals, quartz, feldspar and kaolinite are present invariably in all soils and they are the main or major constituents of the soils.

• The above minerals in soils are also identified by Fourier Transform Infrared Spectroscopy, which are confirmed by Powder X-ray diffraction method.

8.2.5 Findings through SEM-EDX Method

• Scanning Electron Microscopy with Energy Dispersive X-ray (SEM with EDX) is a well established analytical tool for simultaneous determination of the morphological structure and multi-element status of soils.

• It determined the ultra structure of soil and the trace elements like aluminium, calcium, chlorine, iron, iodine, potassium, magnesium, sodium, lead, silicon, titanium and zinc.

• Soils of the study area contain toxic metals such as aluminium, lead, selenium and titanium which are in higher concentration.

• Correlation studies reveal that the distribution of such elements was random. The structure and elemental variations are found and the results are discussed.

8.2.6 Findings through Thermal Analysis

• In TG-DTA curves, weight loss may be attributed in two stages; the result indicates the decomposition of water at first stage and dehydroxylation of kaolinite in the second stage.
- The major soil minerals feature endothermic peaks at temperatures below 200°C due to the loss of adsorbed water and at higher temperatures due to dehydroxylation.

- Four consecutive exothermic peaks at 98, 310, 514, and 586°C for soils are due to removal of hydric water, decomposition of goethite, destruction of kaolinite and conversion of quartz.

- The DTA curves show endothermic peaks at 253°C, exothermic peak at 380°C for soil sample S₂, 252°C, 410°C for S₈, 350°C, 512°C for S₁₄, 252°C, 436°C for S₂₀, 238°C, 500°C for S₂₆, 247°C, 600°C for S₃₂ and they are associated with organic matter decomposition and such transformations are partially hidden by the kaolinite dehydroxylation.

8.3 CONCLUSION

From the literature survey, it has been established that systematic spectroscopic investigations of industrial area soils had been earlier carried out around the world. The present investigation has been undertaken in an industrial region where it had never been tried. Spectroscopic studies revealed that the soils are contaminated by heavy metals released from industrial wastewater. The increasing of heavy metals in all canals can make soil quality poorer; reduce crop yield and the quality of agricultural products. Minerals and heavy metals such as aluminium, lead, silicon and titanium were identified and quantified, and spatial variability in the industrial area among all canals is addressed. The elements are toxic to human and animal health directly or indirectly when they continue to intake the agricultural products cultivated from this area. There should be a control mechanism on soil pollution in industrial areas.
8.4 SCOPE FOR FUTURE WORK

- Seasonal variation of pollutant in the study area will give the profile about the soil pollution for authorities to plan for remedial measures.

- A more detailed study by dividing the study area into different groups like residential area, industrial area and road side area will give more information.

- A combined study for soil and water will provide data on pollution in the industrial area.

- A similar work can be extended to other industrial areas located in the shore of Bay of Bengal.

- Similar analytical research can be implemented to the seaports where regular chemical shipment activities are undertaken.