PHYSICO CHEMICAL INVESTIGATION AND IDENTIFICATION OF TOXIC COMPOUNDS IN INDUSTRIAL WASTE

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ABSTRACT

The following objectives have been formulated for present investigation study.

(i) To study the different sources and nature of the solid wastes generated in mandideep industrial area, Bhopal, Madhya Pradesh.
(ii) To analyse the physico-chemical Investigation of solid industrial wastes
(iii) To evaluation the toxic compound in solid industrial wastes.
(iv) To suggest the renovation, reuse, recycling and proper management for the future.

Reported the selection of study area, Bhopal, Madhya Pradesh, India. The solid waste samples of five locations of Mandideep Industrial area, namely around Pooja chemicals, around Pradeep insecticides and fertilizers co. Pvt. Ltd, around standard surfactant limited, around Suveesha chemicals Pvt. Ltd and around Tirupati Industries are collected during the period Phase-I (July to September, 2017), Phase-II (October to December,2017), Phase-III (January to March, 2018) and Phase-IV (April to June, 2018).

Describes the parameters of physico-chemical for the solid waste samples such as moisture content, pH(Potentio Hydrogenie), electrical conductivity, Total organic content(TOC), Total-carbon-content(TCC), Total-nitrogen(TN), Sulphate, Phosphate, C/N ratio, N/P ratio, Calcium, Magnesium and Chlorides are analysed with standard analytical method. The results of physico-chemical investigation are reported as the moisture contents (36.00 to 62.0%), pH value (6.40 to 7.87),electrical conductivity (1.87 to 6.77 microS/cm), total organic content (15.33 to 42.00%),total carbon content (9.43 to 28.00%),total nitrogen content (1.20 to 6.73%), sulphate values (3.17 to 10.23 mg/L), phosphate values (206.67to 817.00 mg/L), C/N ratio (2.89 to 8.07), N/P ratio (0.01 to 0.50), calcium values(180 to 571 mg/L), values of magnesium (76.67 to 460.67mg/L) and chloride (19.33 to 356.67mg/L).

Keywords: Minerals, Industrial waste, Chemical toxicity, Effluent, Extraction, FTIR, VV-VIS,UV-VIS, PH meter, Physico-chemical

1 Introduction

Information on the nature of solid wastes and its formation along with its chemical and physical characteristics and generated quantities are the basic needs for the planning of solid waste management. Physical and chemical characteristics are refers to those properties, which are more relevant to the collections, storage, treatments and finally the disposal of industrial solid wastes such as density, mass, moisture content, chemical composition and calorific values. The analysis of the characteristics, composition and the quantities of solid wastes arevery essential because that willprovides the basic data on which management system is planned for design and operation, changes and the trend in formation of wastes over a time period are known and which will helps in the future planning and forecasting of tendency assists the designers and manufactures in the production industries of equipment's and vehicles which is suitable for the future needs. The examination of composition and characteristics of solid wastes in different parts of the city underscores the deeply influence on income, social development, socio-economic conditions and the cultural practices and thus we have to focus attention on the importance of locally obtaining the data.

Composition of the solid wastes from all the urban area is similar but its weight, volume and the density varies from place to place, town to town and from cities to cities. It highly depends upon the concentration of population and various functional activities such as the residential, commercial and industrial etc. The geographical factors like the location of city, its climate and weather conditions, life style and socio-economic conditions including income and living condition play a important role in it (Sundaresan, B.B., Bhide A.D., 1987).

1.2 Status of solid wastes generation in Bhopal

Mandideep is the largest industrial area in Madhya Pradesh (India), situated about 27 km away from Bhopal. It is the third among the city belonging the Bhopal unit. The solid waste generated in Bhopal unit are listed in Table 1.1

City	Wards	Population	Total waste generation
Bhopal	85	2411972	909
Mandideep	26	87676	17
Obaidullaganj	15	25286	8
Berasia	18	34370	10
Sehore	35	121453	32
Ichhawar	15	16539	4
Kothri	15	11988	4
Ashta	18	61286	16
Total			**1000**

Table 1.1: Solid waste generation in Bhopal Unit

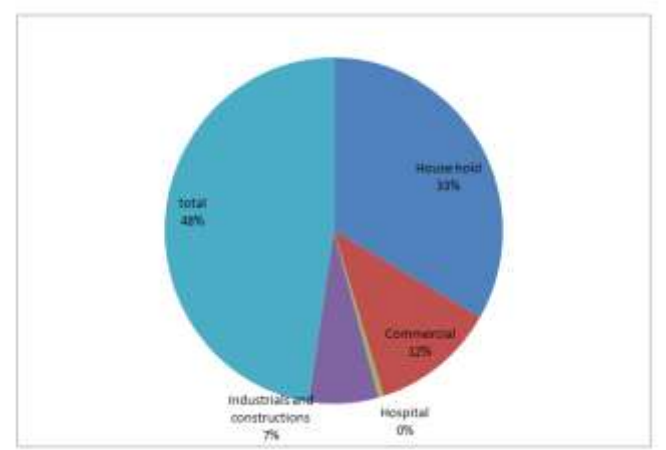

Figure 1.1: Major sources of solid waste Mandideep area proportions by mass

A better knowledge of the physico-chemical characteristics (PCC) of solid waste, i.e. its moisture content, carbon, nitrogen, pH value, organic matter, ash, C/N ration, N/P ratio and phosphate are important parameters in taking decision towards the proper management, and finally evaluating alternative processes as well as energy recovery options. However, if the contents of compostable materials are high, the junk can be used for composting, otherwise it will be used for sanitary land filling. The contents of compostable material are increases with higher ratio of nitrogen and carbon availability in it. The nitrogen provides nutrient and feeder to soil for the growth of plants. For this purposes field investigations are very necessary to provide basic data based on the solid waste characteristics.

1.3 Problem Identification

The Mandideep city is fast developing city in Madhya Pradesh state, India. Lately industrialization is developing in quicker rate than some other exercises. Because of the industrialization, the weight for heavy metals contaminations for the soil, water and air has been continuously expanding. To best discover the heavy metals contaminations from the ventures of the Mandideep, Madhya Pradesh India, which they have liable to be received for their creation purposes, during the most recent couple of decades, has experienced the fast mechanical and financial improvement. Because of this neighbourhood occupants could confront the wellbeing and biological issues if the heavy metal burdens exceeded to a basic worth. Little data is accessible on heavy metal fixations on squander gathered in Mandideep. An enormous number of mechanical exercises produce squanders and contaminants that arrive at the loss through direct removal, spills, releases, barometrical statement from air, and different pathways. Henceforth, improved the metals level (e.g., Copper, Zinc, Lead, Cobalt, Nickel, Cadmium and Arsenic) in the collected solid wastes which has been presented from different industries.

Health hazard brought about by substantial metals to the occupant's waste gathered examples were gathered and dissected for Arsenic (As), Lead (Pb). The deliberate convergences of the heavy metals were utilized to ascertain the wellbeing hazard in the grown-ups and the youngsters. As it is a one of the successful transportation courses of heavy metals and components, the environmental outflows have been commonly designated as the primary course of the metallic collections in soils surfaces by means of their considerable testimony, alongside the other vehicle courses like the waste water release. The greater part of the ground water sources are as yet expected to be sheltered yet once, source is sullied, at that point for all intents and purposes it would be hard to clean.

1.4 Collection of Solid Waste Samples

For our research activity we have collected total 60 sample of solid waste from the five different locations in mandideep industrial area, Bhopal, M.P. during the period July17 to June 18. The solid waste samples1kg of representative solid waste sample was collected as per the standard procedure. These solid samples were collected in polyethene bags by proper making.

1.5 Timing of collection

Phase I: (collection of solid samples during July2017-September2017).

Phase II: (collection of solid samples during October2017-December 2017).

Phase III: (collection of solid samples during January2018-March2018).

Phase IV: (collection of solid samples during April 2018-June2018).

Name of Location	Sample Identification	Number of samples
Around Pooja chemicals	Site I	12
Around Pradeepinstecticides and fertilizers co. Pvt. Ltd,	Site II	12
Around Standard surfactant limted.	Site III	12
Around Suveesha chemicals Pvt. Ltd	Site IV	12
Around Tirupati Industries	Site V	12

Table 1.2: Solid samples collection summary

1.6 Preparation of solid sample

The samples collected were prepared in laboratory with proper care and handling. The samples were dried first in sunlight and then in laboratory oven at 70^0C and ground with pestle and motar and passed through 2mm mesh sieve to obtain uniform fine samples. The obtained fine samples were stored in separate polyethene bag and used for the physico-chemical investigation of solid waste samples such as pH(Potentio Hydrogenie), electrical conductivity, Total organic content(TOC), Total-carbon-content(TCC), Total-nitrogen(TN), Sulphate, Phosphate, C/N ratio , N/P ratio, Calcium, Magnesium and Chlorides are analysed with standard analytical method. The Toxic compound identification of solid waste samples such Copper, Cadmium, Chromium, Iron, Lead, Zinc and Arsenic by Atomic Absorption spectrophotometry.

2. **Material and Methods for physico-chemical investigation**

2.1 Determination of Moisture Content

Each sample (20 g) was weighed into a watch glass of constant weight, heated to 110^oC for 1 hours in an oven, cooled down in a desiccator for 30 min, and finally weighed again to calculate the percentage of moisture by equation [1] as,

$$[W_1-(W_3-W_2)]\times 100, \quad [1]$$

Whereas,

Original samples weight = W_1,
Watch glass weight = W_2, and
Sample weight + watch glass weight = W_3, this weight is after heating and thermal equilibration.

2.2 **pH**(Potentio Hydrogenie)

The term "Potentio Hydrogenie" has been uses globally to express the acidity or alkalinity concentration of a solution.

Apparatus:

Digital pH meter

Reagent:

SolutionBuffer are at pH=3.99, pH=6.99 and pH=8.99

Procedure:

The pH values of solid waste samples (1:5 water extract) of the mandideep industrial area, are directly obtained from the digital pH meter (Bates, 1954).

2.3 Electrical conductivity

Dissolved amount of salts is indicated by Electrical conductivity (EC)and salinity hazardous.

Apparatus:

Digital parameter analyzer kit

Reagent:

Saturated KCl solution

Procedure:

The values of electrical conductivity of solid waste samples (1:5 water extract) of the mandideep industrialarea,are directly obtained from the digital parameter analyzer kit (Godson, et al, 2002).

2.4 Total Nitrogen

The total nitrogen of solid waste samples can be calculated by the semi k-jeldhal method by J.M. Bremmer, and Yeomans, J.C., 1991.

Total kjeldal nitrogen(TKN): It is defined as the expression that describes the whole nitrogen amounts presented in the solid sample (1:5 water extract) which are available into 2 forms:

a) **NH_3-N**: Also known as inorganic-nitrogen. However the Nessler experiment can be determined by using this type of inorganic-nitrogen which we had been used in the previous experimental.

b) Organic-nitrogen: this type of nitrogen is first converted into other types of nitrogen before making any experiments on it.

Calculations:

The total nitrogen content in solid waste samples are calculated by equation [2],

$$NH_3\text{-N (mg /L)} = \frac{(A-B)*280}{sample\ in\ ml} \quad [2]$$

- A = solution of H_2SO_4used to titrate the sample in mili-liter
- B = volume of H_2SO_4used to titrate the blankin mili-liter
- Sample in ml = 50 or 25

2.5 Sulphate (SO_4^{-2})

The vast majority of the sulphate metals are originated by the sulphate oxidation, the outcomes from anhydrite and gypsum because of accessibility of peach stone particularly the sulphates are rich in natural compound and in the presence of the modern industries wastes. The photolytic oxidation of sulphur dioxide produces the sulphur trioxide (SO_3) and theSO_3comesalong with vapour water fumes to shape the sulphuric acids which is sprayed as thesnow or acid downpour. Sulphur carried minerals that are most common in the sedimentary or feculent rocks. In enduring strategy of the gypsum also called $CaSO_4$ "calcium-sulphate" which is soluble and the partly oxidised sulphide minerals groups and producing the upward shake to the dissolvable state of the sulphates that are removed by methods for the water.

The concentrations of sulphate in strong waste samples were measured by the turbid metric technique illustrated by the Butters and Chenery, 1959.

Calculation

$$\text{Mg } SO_4^{-2}\text{mg/L} = \frac{(SO4)\text{ mg x } 1000}{\text{mL of sample}} \quad [3]$$

2.6 Phosphate (PO_4^{-3})

These types are generally categorized into orthophosphates and complete phosphates. Orthophosphates utilized to agricultural lands or composts are passes over the water surface with the rainstorm overflow and to a lower degree with dissolving snowfall. The formation of natural phosphates(PO_4^{-3}) are basically by using the natural procedures. Now these phosphates are added to sewages through person squanders and nourishment deposits. The nearness of phosphate in huge parts in clean waters causes air contamination by means of sewage and mechanical squanders. It advances blast of microorganisms. In spite of the fact that phosphate has issues in floor waters, its essence is critical for natural debasement of wastewaters. Phosphate is a quintessential supplement for the expansion of life forms and aides for the most significant profitability of a constitution of water. The standard of this strategy includes the arrangement of the molybdophosphoric acid, that is utilized to diminished the seriously hued complex, for example molybdenum blue. Anyway this technique is exceptionally touchy and is really down to the groupings of 0.1mg phosphorus per liter of the water. The phosphate fixation in strong waste examples was controlled by Brays No. 1 strategy (Olsen and Sommers, 1982).

The analytical chemical reactions describing this change in colour are the formation of phosphomolybdic acid:

$$72\ H^+ + PO_4^{3-} + 12\ Mo_7\ O_{24}^{6-} \rightarrow 7\ P\ Mo_{12}\ O_{40}^{3-} + 36\ H_2O \quad [4]$$

which is followed by the formation of molybdenum blue from phosphomolybdic acid:

$$PMo_{12}\ O_{40}^{3-} + 2\ C_6H_8O_6 \rightarrow PMo_{12}O_{40}^{7-} + 2\ C_6H_6O_6 + 4\ H^+ \quad [5]$$

2.7 Estimation of $\frac{C}{N}$ ratio

The estimated $\frac{C}{N}$ ratio of solid waste samples are calculated by equation[6],

$$\frac{C}{N} = \frac{\text{Total carbon content in the sample(TCC)}}{\text{Total nitrogen content in the sample(TNC)}} \quad [6]$$

2.8 Estimation of $\frac{N}{P}$ ratio

The estimated ratio of $\frac{N}{P}$ of a solid waste samples are calculated by equation[7],

$$\frac{N}{P} = \frac{\text{Total nitrogen content in the sample(TNC)}}{\text{phosphate content in the sample}} \quad [7]$$

2.9 Calcium and Magnesium hardness

The presence of dissolved minerals for total hardness consists usually total concentrations of cations of magnesium (Mg^{2+}) and calcium (Ca^{2+}).

Taking the formulas for and the structure of Erio-chrome Black-T and EDTA as a H_3ln and H_4Y respectively, then the reaction equations which will occurs during the titrations are:

$$HY^{3-}(aq.)+Ca^{2+}(aq.)\rightarrow CaY^{2-}(aq.) \quad [8]$$

$$HY^{3-}(aq.)+Mg^{2+}(aq.)\rightarrow MgY^{2-}(aq.) \quad [9]$$

The final reactions can be written as the follows:

$$Mgln^{-}(aq.)+HY^{3-}(aq.)\rightarrow Hln^{2-}(aq.)+MgY^{2-}(aq.)$$

Wine red sky blue

Calculation:

Total hardness (as $CaCO_3$) = Molarity x Molecular
= Weight of $CaCO_3$
= (Y/4000) x 100 g/L
= (Y/4000) x 100 x 1000 mg/L (ppm)

Where,

Yml = Volume of E.D.T.A. solution using techniques of Erio-chrome-Black-T as a indicator

Calcium hardness (as $CaCO_3$)= Molarity x Molecular
= Weight of $CaCO_3$
= (Z/4000) x 100 g/L
= (Z/4000) x 100 x 1000 mg/L (ppm)

Where,

Zml = Volume of EDTA solution using Muroxide as Indicator

Magnesium hardness of given water sample = Total hardness-Calcium hardness

2.10 Chloride(Cl^{-})

Chlorides available in natural waters are mostly credited to the disintegration of deposits salt, effluents releases from the substance industries such as seawater interruption in waterfront zones. High chloride content material might also diffuse pipes and constructions as properly as plants from agricultural.
the presence of K_2CrO_4 as a indicator. In this method reactions for chemical are described below:

$$1Ag^{+}+Cl^{-}=AgCl(\text{White-precipitate}) \quad [10]$$

$$2Ag^{+}+CrO_4^{-2}=Ag_2CrO_4(\text{Red-precipitate}) \quad [11]$$

Calculation

$Cl^{-}(\frac{mg}{L})$=(A–B)xNx35.45x1000 per millilitre of the samples

Where,A=mL$AgNO_3$ for samples requirements,

B=mL$AgNO_3$ for blank requirements, and

N is used as a for $AgNO_3$normality

3. Material and Methods for heavy metal analysis

3.1 **Determination of copper**

Copper (Cu) is a very important type of minerals which is most essential for physical and mental health of humans. But due to huge copper occurrence in our food, birth control pill, and nutritional deficiencies tablet increases the chances of copper toxicity. However the copper is not hazards to health and also there is no any poisonous in its state of metallic, but some of the copper salts are little poisonous (Badiye A. et al, 2013).

Reagents:

Copper sulphate, ($CuSO_4.5H_2O$), Nitric acid (HNO_3).

Apparatus: Perkin Elmer Atomic Absorption Spectrophotometricanalyst 400.

Procedure:

a) **Standard-solution:** the copper sulphate solution of 1000 ppm is formed by dissolving 1.984g clear un-efforesed crystal of copper sulphate in 500 ml of 1:1 Nitric acid. Further 100ppm and 1 ppm is prepared by 1000 ppm solution.

b) Analysis of solid waste samples: The copper content in solid waste samples (digested solution) were analysed by Perkin Elmer atomic absorption spectrophotometry analyst 400 at wave length 324.7nM. The data of copper content in solid waste samples are presented in the Table of chapter 5.

3.2 **Determination of cadmium**

Cadmium (Cd) has a considerable toxicity in the heavy metals with the exterminatory impact on most of the organs system. Cadmium is most widely distributed metals in the humans, and the main sources of its pollutions are the smokes, cigarette, welding, polluted food and beverages (Friberg, 1983).

Reagents: Cadmium oxide, Nitric acid (HNO_3).

Apparatus: Perkin Elmer Atomic Absorption spectrophotometric analyst 400.

Procedure:

a) Standard solution: Dissolve 0.1142 grams of cadmium in 100ml of 1:1 Nitric acid to obtained 1000ppm solution. Further 100ppm and 1 ppm is prepared by 1000 ppm solution.

b) Analysis of solid waste samples: The cadmium in solid waste samples (digested solution) were analysed by Perkin Elmer atomic absorption spectrophotometry analyst 400 at wave length 228.8nM. The data of cadmium in solid wastes samples are represented in the Table of chapter 5.

3.3 Determination of Chromium

The essential and natural form of chromium is the chromium III. However, generally the chromium VI is the by-product of the industrial activities and this is considered as more variable and toxic (Paiva et. al, 2009).

Reagents: Potassium dichromate $K_2Cr_2O_7$

Apparatus: Perkin Elmer Atomic Absorption spectrophotometricanalyst 400.

Procedure:

a) Standard solution: Dissolve 2.828 grams of Potassium dichromate in 1 litter of distilled water to obtained 1000ppm solution. Further 100ppm and 1 ppm is prepared by 1000 ppm solution.

b) Analysis of solid waste samples: The Chromium in solid waste sample (digested solution) were analysed by PerkinElmer atomic absorption spectrophotometry analyst 400 at wave length 357.8nM. The data of Chromium in solid wastes samples are represented in the Table of chapter 5.

3.4 Determination of iron

There are large industrial applications for the iron and its compounds (material for construction, water pipes, coagulants in water treatment, food colours, colouring in plastics and paints. Also at a low concentration of iron in

the metals has been played a significant role in the metabolic formation and boiling processes such as stabilizers, enzyme activator and functional component of proteins. Above the certain limits, the iron and its compounds may lead to serious problems such as depression, coma, rapid and shallow respiration, convulsions and cardiac attack (Bag, 1998; Alemdaroglu, 2000; Paleologos, 2002).

Reagents: Ferrous ammonium sulphate, HCl.

Apparatus: Perkin Elmer Atomic Absorption spectro-photo metric analyst 400.

Procedure:

a) Standard solution: Dissolve 0.6931 grams of $(NH4)_2$ $Fe(SO_4)_2 \cdot 6H_2O$ i.e. the "ferrous-ammonium-sulphate" in the double distilled-water. Then this dissolved mixture is mixed with 1L to make the mixture up to 100ppm. Further 10ppm and 0.5 ppm is prepared by 100 ppm solution.

b) Analysis of solid waste samples: The iron content in solid waste samples (digested solution) were analysed by Perkin Elmer atomic absorption spectrophotometry analyst 400 at wave length 248.3nM.

The data obtained were given in the Table of chapter 5.

3.5 Determination of Lead

Lead is most toxic metals in the environment. The properties of lead are malleability, softness, ductility, resistance to corrosion and have a poor thermal conductivity. Which makes the difficult use of its. The toxicity and hazards of environments are increases due to its continuous use and the non-biodegradable nature of lead (Mahaffay et al., 1990).

Lead is most highly toxic metal influencing almost all organs of human body. Therefore the regular monitoring of this metal is required.

Reagents: Lead nitrate, 1:1 nitric acid

Apparatus: Perkin Elmer absorption spectrophotometer analyst 400.

Procedure:

a. Standard solution dilute 1.6 gram lead nitrate in one litre of nitric acid to obtain 1000 ppm solution. Further prepare standard solution of 100 ppm and 10 ppm from 1000 ppm stock solution.

Analysis of lead in solid samples: Lead present in solid samples were analysed by Perkin Elmer absorption spectrophotometer analyst 400 at wavelength 217 nM. The data on lead content present in solid waste samples were reported in the Table of chapter 5.

3.6 Determination of Zinc

Zinc and its compounds are widely used in the manufacture of paints, rubber, cosmetics, paramaceties, plastic inks, soap, batteries textile and electrical equipment (Markert, 1993).So it's excessive exposure in environment create toxicity to living organisms as its essential trace element

Reagent: Zinc metal, 1:1 Nitric acid

Apparatus: Perkin Elmer absorption spectrophotometer analyst 400.

Procedure:

a. Standard solution: to extend 1000 ppm of standard solution dissolve 1 gram of zinc metal in one litre of nitric acid. Further 100ppm and 10ppm solution is prepared from 1000 ppm solution using dilution method.

Analysis of zinc metal in solid waste sample: Zinc contents in solid samples where bye parking Perkin atomic absorption spectrophotometer analyst 400 at wavelength 213.9nM analyse. The data on Zinc content present in solid waste samples were reported in the Table of chapter 5.

3.7 Determination of Arsenic

The Heavy metals in the nature of arsenical compounds or arsenic forms are exceptionally harmful and toxics to the human health. They are generally founds in the form of leachates and effluents of the metallurgical, glass and ceramic industries, dyes, fertilizer production, oil refining and other chemical industries. Part of the world of resin is naturally found in the ground from which it reaches groundwater (choudhuri et.al.,2009)

Reagents:Sodium arsenate, (Na_2HasO_4 $7H_2O$).

Apparatus: Perkin Elmer Atomic Absorption spectrophotometricanalyst 400.

Procedure:

a) Standard solution: 1000 ppm of Sodium arsenatesolution is prepared by dissolving 2.08 grams in 1000 ml distilled water. Further 100ppm and 1 ppm is prepared by 1000 ppm solution.

b) Analysis of solid waste samples: The Arsenic content in solid waste samples (digested solution) were analysed by PerkinElmer atomic absorption spectrophotometry analyst 400 at wave length 193.7nM. The data of Arsenic content in solid waste samples are given in the Table of chapter 5.

4. Result and discussions

Phase-I (July - September, 2017)

The results analysing for the physicochemical investigation for the 5 locations (site-I, site-II, site-III, site-IV and site-V) of Mandideep industrial area, Bhopal, Madhya Pradesh is shown in Table4.1-Table4.5. The moisture-contents(%) of solid waste ranged from 55.00 to 72.10%. The pH of the solid waste varies from 7.00 to 8:10. The electrical conductivity of solid waste was found to be in range of 1.40 to 4.60 mS/cm. The estimated values of total organic content are in the range of 10.90 to 36.00%. Total carbon content is observed in the range between 8.90 to 19.00%. The nitrogen content value of the samples was measured between 0.9 to 4.2 %. The sulphate values was found to be range of 2.40 to 8.00mg/L. The phosphate values were observed in the range between 120.80 to 600.00 mg/L. The C/N ratio were found in the ranged between 2.00 to 9.80. The calcium values of solid waste were varies from 120.00 to 310.00. The values of magnesium were found in the range between 40.00 to 400.00mg/L. The observed value of chloride is solid waste were ranged from 11.00 to 290.00mg/L.

The physico-chemical Parameter of solid waste samples for the 5 locations during phase-I(July- September, 2017) are shown in Figure 4.1 to Figure 4.5.

Phase-II (October - December, 2017)

The observed values of physico-chemical investigation 5 locations (site-I, site-II, site-III, site-IV, and site-V) of Mandideep industrial area, Bhopal, Madhya Pradesh has been represented from table: 4.6 – table: 4.10. The moisture content of solid waste varies from 48.00 to 62.00%. The pH valves were all in the range of 6.80 to 8.60. The EC values of solid waste samples are varied from 1.60 - 5.10mS/cm. Total organic content values is in the range of 15.00 to 40.00%. The estimated values of total carbon values are in the range between 9.00 to 21.07%. The Total nitrogen content values are observed was ranged from 1.80 to 5.00%. The sulphate values of solid waste vary from 3.66 to 8.60 mg/L. The phosphate values were found with range of 200.00 to 700.00 mg/L. The C/N ratio is varied from 2.84 to 7.39. The values of calcium found in solid waste are ranged from 267.0 to 530.0 mg/L). The magnesium values observed in solid varies from 120.00 to 420.00mg/L. The values of estimated chloride present solid wastes varied between 48.00 to 293.00mg/L.

The physico-chemical parameter of solid wastes samples for the all 5 locations during phase-II (October- December, 2017) is shown in Figure 4.6 to Figure 4.10.

Phase-III (January – March, 2018)

The solid waste samples of 5 locations (site-I, site-II, site-III, site-IV, and site-V) of Mandideep industrial area, Bhopal, Madhya Pradesh were analysed for physicochemical parameters. The calculated values are represented from table: 4.11 – table: 4.15.

The moisture content (%) of solid waste ranged from 38.00 to 55.00%. The pH of the solid waste sample were varies from 6.30 to 7.90. The value of electrical conductivity of samples was found to be in range of 1.50 to 6.20 mS/cm. The estimated values of total organic contentof the samples are in the range of 16.00 to 47.00%. The observed values of total carbon content of sample are in the range between10.50 to 24.00%. The total nitrogen content value of the samples was measured between 2.10 to 6.00%. The sulphate values of samples were found to be range of 4:40 to 8.90mg/L. The phosphate values were observed and measured between 10.00 to 8.20mg/L. The C/N ratio were found in the ranged between 4.86 to 7.60. The calcium values of solid samples varies from 270.00 to 610.00 mg/L.

The values of magnesium were measured between 280.00 to 480.00mg/L. The observed values of chloride in solid waste samples were ranged from 56.00 to 319.00 mg/L.

The physico- chemical parameter of solid waste samples of 5 locations(site-I, site-II, site-III, site-IV, and site-V) during phase-III (January- March 2018) is shown in Figure 4.11 to Figure 4.15.

Phase IV (April – June, 2018)

The physico-chemical investigation of waste samples of 5 location (site-I, site-II, site-III, site-IV, and site-V) of Mandideep industrial area, Bhopal, MadhyaPradesh during April-June, 2018 are presented from the table: 4.16 – table: 4.20. The moisture content of solid waste samples varies from 32.00 to 50.00%. The pH values were able to the range of 5.90 to 7.40. The Electrical conductivity of solid waste samples, ranged from 1.80 to 7.30mS/cm. Total organic content values is in the range of 25.00 to 49.00 %. The estimated values of total carbon values are the range between 11.20 to 32.00%.

The total nitrogen content values are observed was ranged from 2.20 to 7.20%. The sulphate value of solid waste varies from 4.80 to 11.20 mg/L. The phosphate values were varied from 232.00 to 823.00mg/L. The C/N ratios are varied from 2.86 to 8.08. The values of calcium found in solid waste are ranged from 299.00 to 576.00 mg/L. The Magnesium values observed in solid varies from 260.00 to 490.00mg/L. The values of chloride found in solid waste are ranged from 56.00 to 322.00mg/L.

The physic-chemical parameter of solid waste samples for all the 5 locations during phase-IV (April-June, 2018) is shown in the Figure 4.16 to Figure 4.20.

The physic-chemical parameter of solid waste samples for all the 5 locations during phase-IV (April-June, 2018) is shown in the Figure below.

Values of moisture-content, pH, EC, total-organic-content, total-carbon-content, Total Nitrogen, sulphate, phosphate , C/N ratio , N/P ratio, calcium, magnesium and chlorides solid waste sample of site I , mandideep industrial area on phase I(July-September, 2017)

S.No.	Parameters	July	August	September
1	Moisture content(%)	60.00	57.00	55.00
2	pH	8.10	7.90	7.60
3	Electrical conductivity(mS/cm)	3.90	4.10	4.60
4	Total organic content(%)	14.00	17.00	22.00
5	Total carbon content(%)	8.90	9.20	10.20
6	Total nitrogen (%)	0.90	1.20	1.50
7	Sulphate(mg/L)	2.40	3.50	3.60
8	Phosphate (mg/L)	195.00	230.00	290.00
9	C/N ratio	9.80	7.60	6.80
10	N/P ratio	0.46	0.52	0.51
11	Calcium(mg/L)	120.00	190.00	230.00
12	Magnesium(mg/L)	40.00	90.00	100.00
13	Chlorides(mg/L)	11.00	22.00	25.00

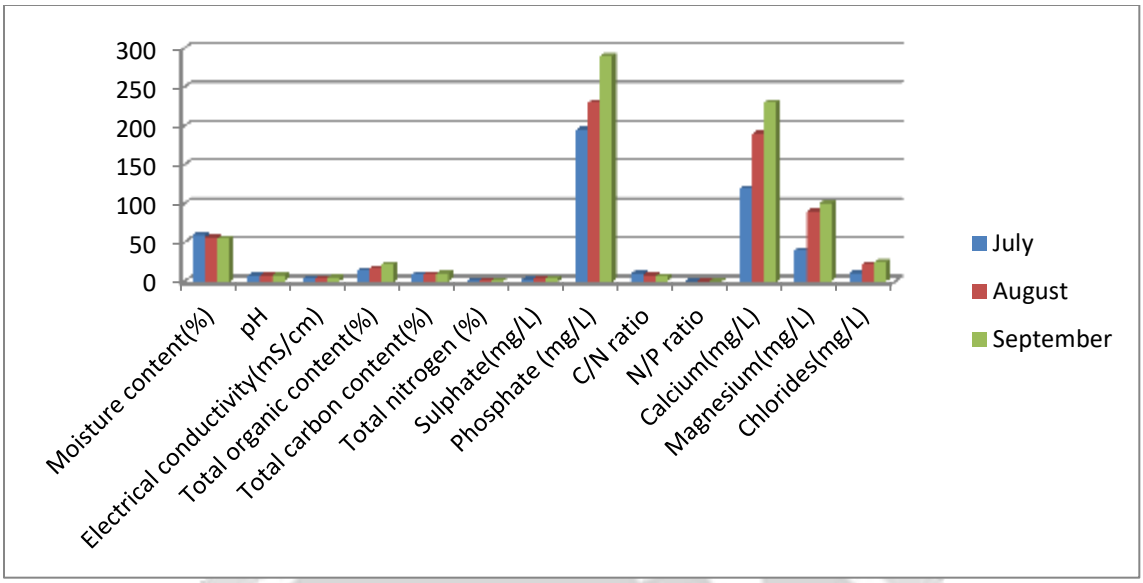

Figure 4.1: Physico-chemical parameter of site I versus Phase I (July- September, 2017) of Mandideep Industrial area.

Values of moisture-content, pH, EC, total-organic-content, total-carbon-content, Total Nitrogen, sulphate, phosphate , C/N ratio , N/P ratio, calcium, magnesium and chlorides solid waste sample of site I , mandideep industrial area on phase II(October-December, 2017)

S.No.	parameters	October	November	December
1	Moisture content(%)	55.00	49.00	52.00
2	pH	7.80	7.60	7.40
3	Electrical conductivity(mS/cm)	4.70	4.90	5.10
4	Total organic content(%)	21.00	24.00	27.00
5	Total carbon content(%)	11.20	12.30	12.90
6	Total nitrogen (%)	1.90	1.80	2.10
7	Sulphate(mg/L)	3.66	3.70	3.73
8	Phosphate(mg/L)	320.00	322.00	384.00
9	C/N ratio	5.89	6.83	6.14
10	N/P ratio	0.01	0.01	0.01
11	Calcium(mg/L)	290.00	280.00	297.00
12	Magnesium(mg/L)	160.00	190.00	198.00
13	Chlorides(mg/L)	48.00	50.00	53.00

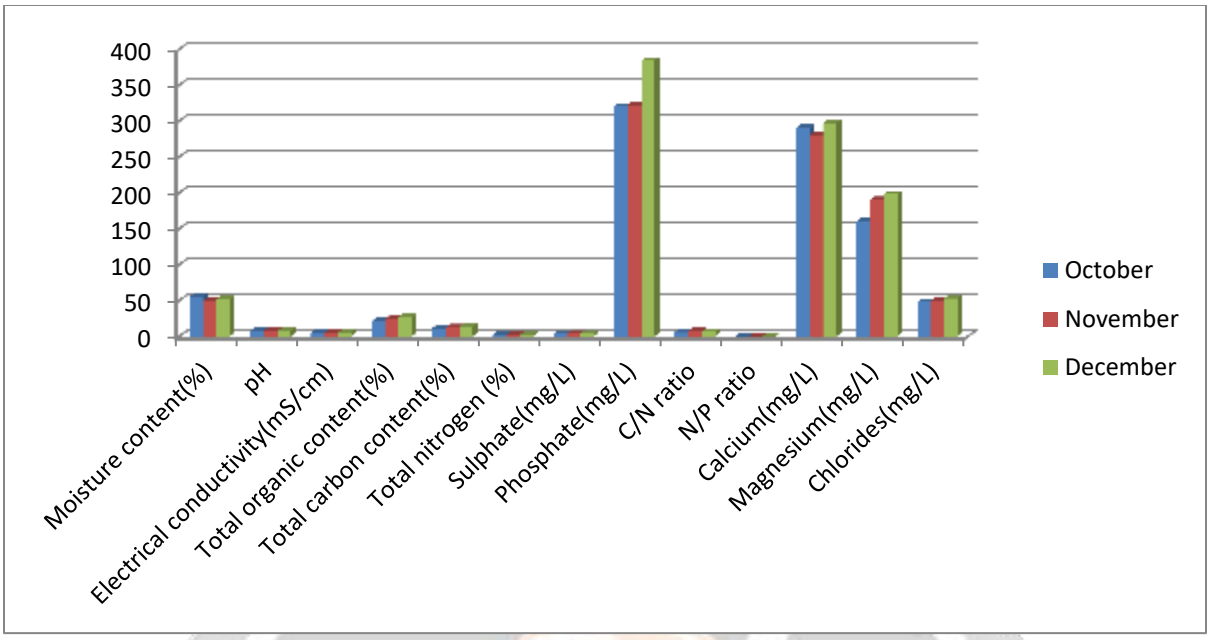

Figure 4.2: Physico chemical Parameter of site I versus Phase II (October- December, 2017) of Mandideep Industrial area.

Values of moisture-content, pH, EC, total-organic-content, total-carbon-content, Total Nitrogen, sulphate, phosphate , C/N ratio , N/P ratio, calcium, magnesium and chlorides solid waste sample of site I , mandideep industrial area on phase III (January-March 2018)

S.No.	Parameters	January	February	March
1	Moisture content(%)	48.00	45.00	43.00
2	pH	7.20	6.80	6.60
3	Electrical conductivity(mS/cm)	5.20	5.90	6.20
4	Total organic content(%)	25.00	28.00	31.00
5	Total carbon content(%)	14.00	15.80	16.70
6	Total nitrogen (%)	2.90	3.40	3.90
7	Sulphate(mg/L)	4.20	4.50	4.80
8	Phosphate(mg/L)	390.00	398.00	410.00
9	C/N ratio	4.83	4.65	4.28
10	N/P ratio	0.01	0.01	0.01
11	Calcium(mg/L)	270.00	300.00	320.00
12	Magnesium(mg/L)	240.00	250.00	255.00
13	Chlorides(mg/L)	56.00	59.00	61.00

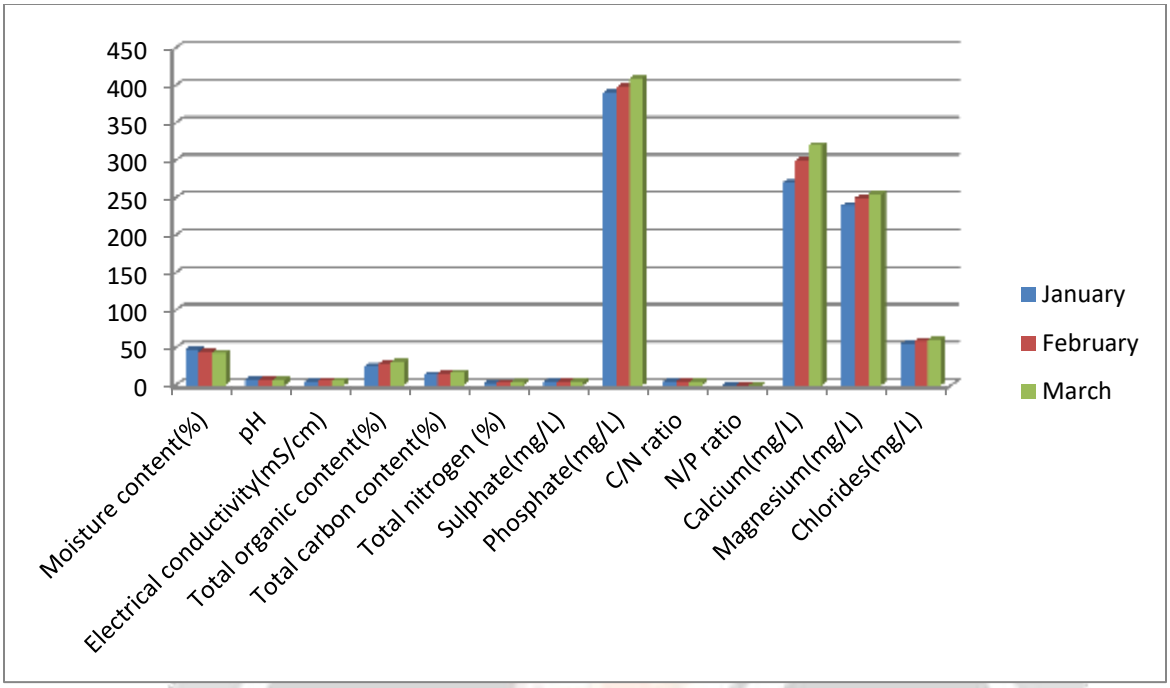

Figure 4.3: Physico-chemical Parameter of site I versus Phase III (January- March, 2018) of Mandideep Industrial area.

Values of moisture-content, pH, EC, total-organic-content, total-carbon-content, Total Nitrogen, sulphate, phosphate, C/N ratio, N/P ratio, calcium, magnesium and chlorides solid waste sample of site I , mandideep industrial area on phase IV (April-June, 2018)

S.No.	Parameters	April	May	June
1	Moisture content (%)	42.00	38.00	36.00
2	pH	7.00	6.60	6.70
3	Electrical conductivity(mS/cm)	5.90	6.50	6.80
4	Total organic content (%)	32.00	33.00	37.00
5	Total carbon content (%)	24.00	28.00	32.00
6	Total nitrogen (%)	4.20	4.60	5.00
7	Sulphate(mg/L)	4.90	4.80	5.00
8	Phosphate(mg/L)	404.00	415.00	415.00
9	C/N ratio	5.71	6.09	6.40
10	N/P ratio	0.01	0.01	0.01
11	Calcium(mg/L)	322.00	325.00	330.00
12	Magnesium(mg/L)	265.00	270.00	260.00
13	Chlorides(mg/L)	56.00	67.00	78.00

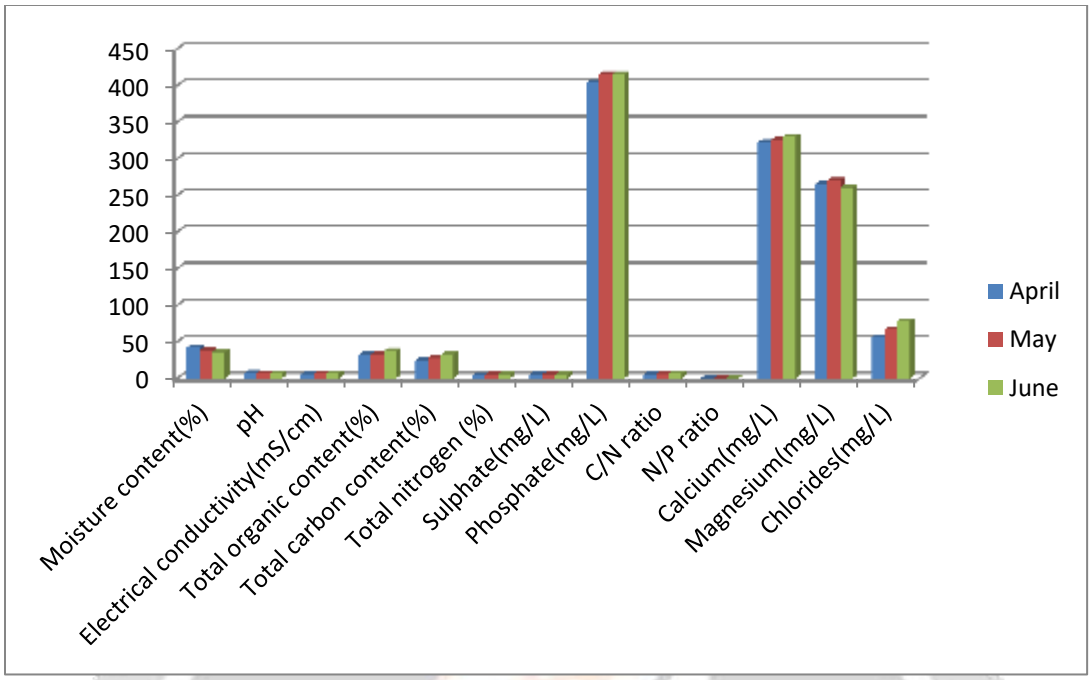

Figure 4.4: Physico-chemical Parameter of site V versus Phase III (January- March, 2018) of Mandideep Industrial area.

Analysis of copper

Phase I (July- September, 2017)

The values of copper content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-I are listed in Table 5.1. The value of copper in solid waste samples varied from 50.00 to 315.40 mg/Kg. The highest value of copper content was found at Site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-V (Around Tirupati Industries)

Phase II(October - December, 2017)

The observed values of copper content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-II are given in Table 5.2. The value of copper in solid waste samples varies between from 74.00 to 340.70 mg/Kg. The highest value of copper content was found at Site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-V (Around Tirupati Industries) respectively.

Phase III(January - March, 2018)

The estimatesvalues of copper content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-III are given in Table 5.3. The value of copper in solid waste samples ranged from 87.00 to 355.00 mg/Kg. The highest value of copper content was found at Site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-V (Around Tirupati Industries) respectively.

Phase IV(April - June, 2018)

The estimates values of copper content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-IV are given in Table 5.4. The value of copper in solid waste samples ranged from

112.00 to 384.00 mg/Kg. The highest value of copper content was found at Site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-V (Around Tirupati Industries) respectively.

Analysis of Cadmium

Phase I (July- September, 2017)

The values of cadmium concentration in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-I are given in Table5.5. The cadmium values in solid waste samples varied from 3.64 to 9.00 mg/Kg. The highest value of cadmium content was found at Site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-III (Around Standard surfactant limited)

Phase II(October - December, 2017)

The observed values of cadmium concentration in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-II are given in Table 5.6. The value of cadmium in solid waste samples varies between from 5.15 to 13.67mg/Kg. The highest value of cadmium content was found at Site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-III (Around Standard surfactant limited) respectively.

Phase III (January - March, 2018)

The estimates values of cadmium concentration in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-III are listed in Table 5.7. The value of cadmium in solid waste samples ranged from 5.97 to 14.89 mg/Kg. The highest value of cadmium content was found at Site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-III (Around Standard surfactant limited) respectively.

Phase IV(April - June, 2018)

The estimates values of cadmiumconcentration in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-IV are presented in Table 5.8. The value of cadmium in solid waste samples ranged from 6.63 to 20.80 mg/Kg. The highest value of cadmium content was found at Site-II (Around Pradeep insecticides and fertilizers co. p. LTD) and lowest at Sites-III (Around Standard surfactant limited) respectively.

Analysis of Chromium

Phase I (July- September, 2017)

The values of chromium content obtained in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-I are presented in the Table 5.9. The Chromium values in the solid waste samples are varies between the 27.72 to 79.84 mg/Kg. The maximum value of chromium content was found at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals P. LTD) respectively.

Phase II(October - December, 2017)

The observed values of chromium content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-II are given in Table 5.10. The value of chromium in solid waste samples varies between from 29.22 to80.90 mg/Kg. The highest value of chromium content was found at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase III(January - March, 2018)

The estimates values of chromium in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-III are listed in Table 5.11. The value of chromium in solid waste samples ranged from 30.04 to 81.29 mg/Kg. The highest value of chromium content was found at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase IV (April - June, 2018)

The estimates values of chromium in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-IV are presented in Table 5.12. The value of chromium in solid waste samples ranged from 30.70 to 82.85 mg/Kg. The highest value of chromium content was found at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Analysis of Iron

Phase I (July- September, 2017)

The values of Iron content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-I are listed in Table 5.13. The value of iron in solid waste samples varied from 0.70 to 3.77 mg/Kg. The iron content was highest at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase II(October - December, 2017)

The observed values of Iron content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-II are given in Table 5.14. The value of iron in solid waste samples varies between from 1.48 to 4.29 mg/Kg. The highest value of iron content was found at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase III(January - March, 2018)

The estimates values of Iron content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-III are given in Table 5.15. The value of iron in solid waste samples varied between 1.92 to 4.84mg/Kg. The highest values of iron content was found at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase-IV(April - June, 2018)

The estimates values of iron content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-IV are given in Table 5.16. The values of iron in solid waste samples are varied between 2.37 to 5.20mg/Kg. The maximum value of iron content was obtained at Site-V (Around Tirupati Industries) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Analysis of lead

Phase I (July- September, 2017)

The values of lead content observed in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-I are presented in the Table 5.17. The Lead values in the solid waste samples are varies between the 21.70 to 81.90 mg/Kg. The maximum value of lead content was found at Site-I (around Pooja chemicals) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase II (October - December, 2017)

The examined values of lead content in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-II are given in Table5.18. The value of lead in solid waste samples varies between from 23.70 to 85.50 mg/Kg. The highest value of lead content was found at Site Site-I (around Pooja chemicals)and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase III (January - March, 2018)

The estimates values of lead in solid waste samples of 5 locations(site-I, site-II, site-III, site-IV and site-V) during the period of phase-III are listed in Table 5.19. The value of lead in solid waste samples ranged from 25.70 to 87.90 mg/Kg. The highest value of lead content was found at Site-I (around Pooja chemicals) and lowest at Site-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase IV(April - June, 2018)

The estimates values of lead in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-IV are presented in Table 5.20. The value of lead in solid waste samples ranged from 26.70 to 90.00 mg/Kg. The highest value of lead content was found at Site-I (around Pooja chemicals) and lowest at Site-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Analysis of zinc

Phase I (July- September, 2017)

The values of zinc content observed in solid waste samples of 5 locations(site-I, site-II, site-III, site-IV and site-V) during the period of phase-I are presented in the Table 5.21. The values of the zinc in solid waste samples are varies between the 71.70 to 274.00 mg/Kg. The highest value of zinc content was found at Site-I (around Pooja chemicals) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase II(October - December, 2017)

The examined values of zinc content in solid waste samples of 5 locations(site-I, site-II, site-III, site-IV and site-V) during the period of phase-II are given in Table 5.22. The value of zinc in solid waste samples varies between from 74.70 to 275.50 mg/Kg. The highest value of zinc content was found at Site-I (around Pooja chemicals)and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase III(January - March, 2018)

The estimates values of zinc in solid wastesamples of 5 locations(site-I, site-II, site-III, site-IV and site-V) during the period of phase-III are listed in Table 5.23. The value of zinc in solid waste samples ranged from 77.00 to 276.70 mg/Kg. The highest value of zinc content was found at Site-I (around Pooja chemicals) and lowest at Site-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase IV(April - June, 2018)

The estimates values of zinc in solid wastesamples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-IV are presented in Table 5.20. The value of zinc in solid waste samples ranged from 79.00to 279.68mg/Kg. The highest value of zinc content was found at Site-I (around Pooja chemicals) and lowest at Site-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Analysis of Arsenic

Phase I (July- September, 2017)

The values of arsenic content observed in solidwaste samples of 5 locations(site-I, site-II, site-III, site-IV and site-V) during the period of phase-I are presented in the Table 5.25. The values of the arsenic in solid waste samples are varies between the 12.90 to 64.00 mg/Kg. The maximum value of arsenic content was found at Site-II (around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase II(October - December, 2017)

The examined values of arsenic content in solid wastesamples of 5 locations(site-I, site-II, site-III, site-IV and site-V) during the period of phase-II are given in Table 5.26. The value of arsenic in solid waste samples varies between from 14.96 to 65.50 mg/Kg. The highest value of arsenic content was found at Site-II (around Pradeep insecticides and fertilizers co. Pvt. Ltd) and lowest at Sites-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase III(January - March, 2018)

The estimates values of zinc in solid waste samples of 5 locations(site-I, site-II, site-III, site-IV and site-V) during the period of phase-III are listed in Table 5.27. The value of zinc in solid waste samples ranged from 17.86 to 67.58 mg/Kg. The highest value of zinc content was found at Site-I (around Pooja chemicals) and lowest at Site-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Phase IV (April - June, 2018)

The estimates values of arsenic in solid waste samples of 5 locations (site-I, site-II, site-III, site-IV and site-V) during the period of phase-IV are presented in Table 5.28. The value of arsenic in solid waste samples ranged from 25.76to 69.68mg/Kg. The highest value of arsenic content was found at Site-I (around Pooja chemicals) and lowest at Site-IV (Around Suveesha chemicals Pvt. Ltd) respectively.

Values of Copper, Cu, (Mg/Kg) Concentration In Solid Samples of 5 locations (Site-I, Site-II, Site-III, Site-IV And Site-V) of Mandideep Industrial Area on Phase I (July-September, 2017)

S. No.	LOCATIONS	JULY	AUGUST	SEPTEMBER
1	Site I	82.80	89.40	90.80
2	Site II	300.00	308.00	315.40
3	Site III	112.00	118.60	120.00
4	Site IV	92.00	98.60	100.00
5	Site V	50.00	58.00	65.40

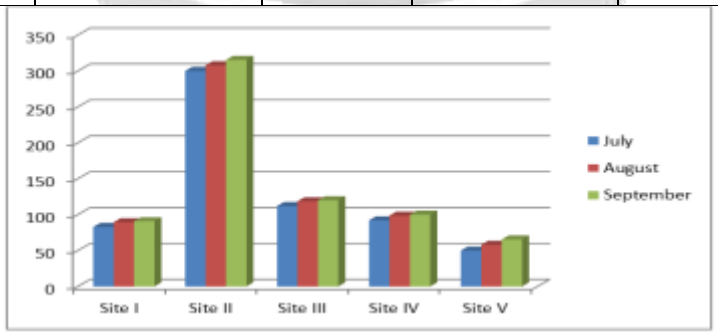

Figure 4.5: The copper, Cu (mg/Kg) content of 5 locations versus phase-I(July-September, 2017) of Mandideep Industrial area.

Values of Cadmium, Cd, (Mg/Kg) Concentration In Solid Samples of 5 locations (Site-I, Site-II, Site-III, Site-IV And Site-V) of Mandideep Industrial Area on Phase-I (July-September, 2017)

S. No.	LOCATIONS	JULY	AUGUST	SEPTEMBER
1	Site I	7.20	6.80	7.89
2	Site II	8.60	8.98	9.00
3	Site III	4.05	3.65	4.74
4	Site IV	4.12	3.72	4.81
5	Site V	5.15	4.75	5.84

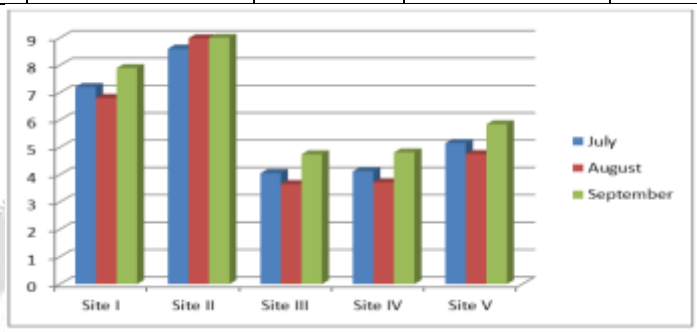

Figure 4.6: Cadmium, Cd (mg/Kg) content of 5 locations versus phase-I(July-September, 2017) of Mandideep Industrial area.

Values of Chromium, Cr (Mg/Kg) Concentration In Solid Samples of 5 locations (Site-I, Site-II, Site-III, Site-IV And Site-V) of Mandideep Industrial Area On Phase I (July-September, 2017)

S. No.	LOCATIONS	JULY	AUGUST	SEPTEMBER
1	Site I	44.20	43.80	44.89
2	Site II	55.60	55.98	56.00
3	Site III	36.05	35.65	36.74
4	Site IV	28.12	27.72	28.81
5	Site V	79.15	78.75	79.84

Figure4.7: The Chromium, Cr (mg/Kg) content of 5 locations versus phase-I(July-September, 2017) of Mandideep Industrial area.

Values of Iron, Fe (Mg/Kg) Concentration In Solid Samples of 5 locations (Site-I, Site-II, Site-III, Site-IV And Site-V) of Mandideep Industrial Area on Phase I (July-September, 2017)

S. No.	LOCATIONS	JULY	AUGUST	SEPTEMBER
1	Site I	1.23	1.50	1.80
2	Site II	3.02	3.29	3.59
3	Site III	1.22	1.49	1.79

4	Site IV	0.70	0.97	1.27
5	Site V	3.20	3.47	3.77

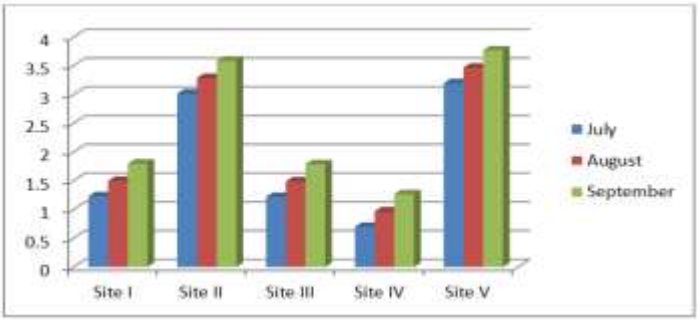

Figure 4.8: The Iron, Fe (mg/Kg) content of 5 locations versus phase-I(July-September, 2017) of Mandideep Industrial area.

Values of Lead, Pb (Mg/Kg) Concentration In Solid Samples of 5 locations (Site-I, Site-II, Site-III, Site-IV And Site-V) of Mandideep Industrial Area on Phase-I (July-September, 2017)

S. No.	LOCATIONS	JULY	AUGUST	SEPTEMBER
1	Site I	80.00	81.20	81.90
2	Site II	49.70	50.90	51.60
3	Site III	36.70	37.70	38.70
4	Site IV	21.70	22.70	23.70
5	Site V	79.01	80.21	80.91

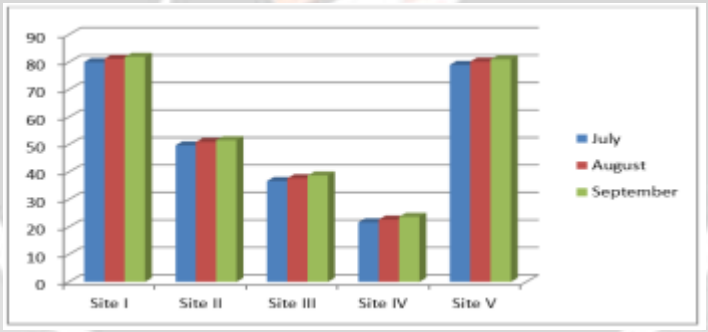

Figure 4.9: The Lead, Pb (mg/Kg) content of 5 locations versus phase-I(July-September, 2017) of Mandideep Industrial area.

Values of Zinc, Zn, (Mg/Kg) Concentration In Solid Samples of 5 locations (Site-I, Site-II, Site-III, Site-IV And Site-V) of Mandideep Industrial Area on Phase I (July-September, 2017)

S. No.	LOCATIONS	JULY	AUGUST	SEPTEMBER
1	Site I	270.10	272.70	274.00
2	Site II	187.00	187.70	189.30
3	Site III	140.96	141.16	141.19
4	Site IV	71.70	72.90	74.10
5	Site V	159.01	160.21	160.91

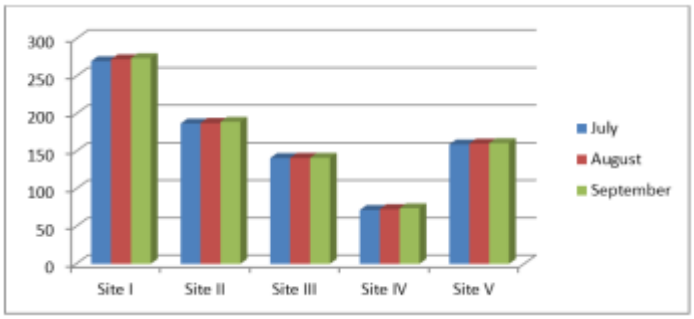

Figure 4.10: The Zinc, Zn (mg/Kg) content of 5 locations versus phase-I(July-September, 2017) of Mandideep Industrial area.

Values of Arsenic, As, (Mg/Kg) Concentration In Solid Samples of 5 locations (Site-I, Site-II, Site-III, Site-IV And Site-V) of Mandideep Industrial Area on Phase-I (July-September, 2017)

S. No.	LOCATIONS	JULY	AUGUST	SEPTEMBER
1	Site I	24.00	24.70	26.30
2	Site II	60.10	62.70	64.00
3	Site III	24.01	25.21	25.91
4	Site IV	12.96	13.16	13.19
5	Site V	35.21	36.41	37.11

Figure 4.11: The arsenic, As (mg/Kg) content of 5 locations versus phase-I(July-September, 2017) of Mandideep Industrial area.

5. *Conclusion*

The average moisture contents (%) of solid waste samples ranged from 57.33 to 62.0%. The average pH value of the solid waste samples varies from 7.47 to 7.87. The average electrical conductivity of solid waste samples was found to be in range of 1.87 to 4.20mS/cm.The average estimated values of total organic content of the samples of solid waste are varies between the 15.33 to 23.33%. Average total carbon content is observed in the range between 9.43 to 11.80%. The average total nitrogen content value of the samples was measured between 1.20 to 3.8%.The average sulphate values was found to be range of 3.17 to 7.87 mg/L. The average phosphate values were observed in the range between 206.67to 570.0 mg/L. The average C/N ratio were found in the ranged between 3.11 to 8.70. The average calcium values of solid waste samples were varies from 180 to 470mg/L. The average values of magnesium were found in the range between 76.67 to 356.37mg/L. The average observed value of chloride is solid waste were ranged from 19.33 to 113.33mg/L.

Copper:

The average Cu concentration was varied from 57.80 to 373.101 as shown in Figure 6.14.The highest Cu concentration was found at site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd.). The copper enters into the ecosystem through so many of the sources like house device, wood and metal manufacturing industry, animal manures, pesticide usage and septic tanks.

Cadmium:
The perusal of the data presented that in Figure 6.15. The average Cd concentration was varied from 4.15 to 18.37. The maximum average value of Cd concentration was 18.37at site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd.). It is very toxic to the animals and plants. However the plants' exposure to cadmium causes the reductions in photosynthesis.

Chromium:
Plastic wastes, sewages and the septic wastes are the main sources for the pollution of chromium (Cr) in the environment. The concentrations of chromium are varied from 4.15 to 18.37and the values are shown in Figure 6.16.The highest Cr concentration level was measured at site-II (Around Pradeep insecticides and fertilizers co. Pvt. Ltd.).The essential and natural substance of chromium is the chromium -III, however the chromium-VI is the byproduct from the industries and has been considered as more radioactive and toxic (Paivaet al., 2009).

Iron:
The values of Iron content in samples were in the ranged from 0.98 to 5.04.The highest total Fe concentration was measured at site-V (around Tirupati industries). The values are shown in Figure 6.17.

Lead:
The average Pb concentration was varied from 19.25 to 89.00as shown in Figure 6.18. The highest Pb concentration was found at site-I (Around Pooja chemicals). Lead can take place from the contact with water, oxygen, dust, soil and industrial merchandise. The main causes of environmental pollutions are the use of Lead (Pb) by industries, such as, metal recycling and foundries, lead wire or pipes, lead acid batteries.

Zinc:
According to the figure 6.19, Zn concentration was varied from 69.45 to 273.18. The highest Zn concentration was found at site-I (around Pooja chemicals). However there are so many of the sources of Zn like the fossil fuels,fertilization and metal manufacturing unnits (Markert, 1993).

Arsenic:
In many industrial the arsenic isused as raw materials, production, and the solid wastes is a contaminant in soil. According to Figure 6.20, As concentration varied from 20.36 to 63.18. In this study As concentration ware highest at site II (around Pradeep insecticides and fertilizers co. Pvt. Ltd.). The products from the industries which contain arsenics are incorporated with semiconductors, herbicides, pharmaceuticals, colors, paints and wood additives. In our environment, artificial sources of arsenic productions included the agricultural applications, mining, burning of fossils fuel, cement manufacturing, pulp and paper production industries (U.S.EPA. 2000).

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