CHAPTER – III

CHAPTER III
RESULTS AND DISCUSSIONS

3.1 Introduction

Brick Industry is an ancillary to the construction industry. Therefore, the existence and future of brick industry is intimately connected with the growth of the construction industry. Considering India as a whole, about 100 bricks are consumed per year per person (an estimated 100 billion bricks consumed by a present population of about 990 million i.e. the present Consumption Factor (CF) is 100.,This varies with the development stage of a region, from 125 to 150 for a rapidly developing area, to over 200 for mega cities. As per the 1991 Census, the population of Maharashtra was 78.75 million. The population growth for the country was 23.50 per cent (or 2.15 per cent per year) for the decade 1981-1991. Applying the same growth rate for the period 1991-1998, Maharashtra's 1991 population may be estimated at about 92 million. Multiplying this by a CF of 125, on a very conservative basis, the present consumption of bricks in Maharashtra works out to 11.50 billion bricks per year (www.damleclaystructurals.com, article 6, 2004). Thus figure would be much higher in 2006 considering in prudential growth in housing and construction in state.

It is an accepted fact in the construction industry that supply of bricks always matches their demand. Going by this observation, the present production of bricks in Maharashtra should at least be 11.50 billion nos. per year. Majority of burnt clay brick manufacturers in Maharashtra employ hand-moulding, sun-drying and clamp-burning methods and work for 6 to 7 months of a year only, from November to May. Assuming that the average production of these brick kilns is about 10 lakh bricks per season per unit, there are about 11,500 units in the State. They are mostly clustered in the vicinity of either developed markets (like Mumbai, Pune, Nagpur, Nashik, Thane, Solapur, Aurangabad, Kolhapur, Sangli, Bhiwandi, Malegaon, Dhule, etc.) or around abundant raw material sources. The sizes of open clamps vary between 25,000 nos. and 10,00,000 nos. (www.damleclaystructurals.com, article 5, 2004)

The Moving Chimney Kiln culture in Maharashtra is only present in Bhiwandi / Ambarnath area (District Thane), Raigad, Nandurbar, Jalgaon, Nagpur and Chandrapur Districts in Maharashtra. The total number of these kilns may be estimated to about 100. Their capacities vary between 10,000 to 50,000 bricks per day, the average being 20,000 bricks per day. The 'mistries' 'setters' and 'firemen' normally come from Gujarat, Punjab or Western U.P. There is only one High Draught Kiln in operation in the State at Murud (District Latur) of 30,000 bricks per day capacity. There are no Fixed Chimney Kilns in existence at present in Kolhapur as in many other places like West Bengal. (Plate VI (a))

It is believed that nature takes about 70-100 years to make an inch of topsoil. Use of this precious surface soil for brick making, though considered desirable by both sellers and buyers of the raw material, destroys it permanently. This practice adversely affects the acre of valuable cultivable land, the flora and fauna supported by it and the environment around. Under the Minor Minerals Act, Government charges a royalty to brick manufacturers at the rate of Rs. 14.00 to Rs. 50.00 per 100 cft of clay. This is expected to take care of cost of reclamation of the affected land which is just a mockery considering this fertile soil can not be replaced. However, in practice, the reclamation cost is tens of thousands of times more than the royalty being levied. Use of firewood for brick burning, which leads to large-scale tree felling in the vicinity of villages and forests causing major ecological problem. The air pollution created by the industry in the form of dust, smoke, poisonous gases and odour also causes serious health hazards to people. Incidence of bonded and child labour, ill treatment to animals engaged in / material handling, etc., evokes considerable uproar from social workers.

3.2 Air Quality Monitoring Results

Air is one of the important natural resources and quality of air therefore become vital particularly in urban and rural areas. Brick industry is one of the air polluting industry. In the brick kilns, the bricks are fired for about 21 days in furnace. The incomplete combustion of the fuel creates serious air pollution. The main air pollutants are Suspended Particulate Matter (SPM), various noxious gases (SO_2, NO_x, CO etc.) and aerosols. The pollution seriously affects the flora and fauna of that region.

During the study the four air pollution parameters viz. SPM, RSPM. SO_2, and NO_x, were monitored at the five identified brick industry sites namely Bapat camp, Shiroli naka, Gandhinagar, Waliwade, Uchgaon in and around Kolhapur city. The results of these observations are given below in the tables 3.1 to Table 3.5

Table 3.1 Air quality at Bapat Camp site

Sr. No.	Date of Sampling	Weather Condition	Parameters (µg/m^3)			
			SO_2	NO_x	RSPM	SPM
1.	10-10-2004	Cloudy	41.33	181.89	539.80	1005.02
2.	13-10-2004	Clear	36.72	96.94	561.01	984.30
3.	14-10-2004	Clear	44.19	153.12	612.23	1096.89
4.	26-02-2005	Clear	67.14	125.60	605.92	1020.30
5.	27-02-2005	Clear	63.11	144.20	663.42	997.24
6.	02-03-2005	Clear	66.06	138.50	687.04	903.19
7.	12-07-2005	Cloudy	11.79	24.31	160.40	479.10
8.	13-07-2005	Cloudy	10.28	22.86	145.80	360.30
9.	14-07-2005	Rainy	6.52	16.02	64.50	172.80

Table 3.2 Air quality at Shiroli Naka site

Sr. No.	Date of Sampling	Weather Condition	Parameters (µg/m^3)			
			SO_2	NO_x	RSPM	SPM
1.	18-10-2004	Clear	76.94	139.40	708.98	968.80
2.	21-10-2004	Cloudy	68.58	134.90	814.50	901.40
3.	22-10-2004	Cloudy	59.91	99.84	604.39	894.03
4.	13-03-2005	Clear	82.60	132.50	612.01	868.98
5.	14-03-2005	Clear	87.04	145.70	668.41	915.20
6.	15-03-2005	Clear	79.17	142.20	428.64	974.14
7.	15-07-2005	Rainy	24.93	59.50	112.40	254.10
8.	16-07-2005	Rainy	26.85	61.91	110.40	272.90
9.	17-07-2005	Rainy	19.53	44.36	81.25	233.33

Table 3.3 Air quality at Gandhinagar site

Sr. No.	Date of Sampling	Weather Condition	Parameters ($\mu g/m^3$)			
			SO_2	NO_x	RSPM	SPM
1.	23-10-2004	Clear	67.14	125.60	612.05	924.40
2.	24-10-2004	Clear	63.11	144.20	418.37	827.20
3.	26-10-2004	Clear	54.18	95.74	367.44	623.53
4.	19-03-2005	Clear	79.92	90.61	499.65	852.43
5.	20-03-2005	Clear	86.98	104.92	898.99	961.48
6.	21-03-2005	Clear	49.15	144.14	568.43	824.76
7.	02-09-2005	Rainy	10.13	43.55	102.50	160.41
8.	03-09-2005	Rainy	9.06	41.19	84.16	137.49
9.	04-09-2005	Rainy	9.33	21.27	95.83	112.49

Table 3.4 Air quality at Walivade site

Sr. No.	Date of Sampling	Weather Condition	Parameters ($\mu g/m^3$)			
			SO_2	NO_x	RSPM	SPM
1.	28-10-2004	Clear	16.83	50.78	157.40	440.53
2.	05-11-2004	Clear	12.63	61.03	172.90	328.41
3.	06-11-2004	Clear	17.15	59.71	156.10	216.40
4.	25-03-2005	Clear	20.76	58.62	290.00	389.42
5.	26-03-2005	Clear	11.62	50.24	188.90	448.96
6.	27-03-2005	Clear	20.07	68.32	126.31	233.54
7.	05-09-2005	Rainy	8.51	36.88	39.58	122.91
8.	06-09-2005	Rainy	6.38	30.68	33.33	64.53
9.	07-09-2005	Rainy	7.46	35.02	54.16	237.49

Table 3.5 Air quality at Uchgaon site

Sr. No.	Date of Sampling	Weather Condition	Parameters ($\mu g/m^3$)			
			SO_2	NO_x	RSPM	SPM
1.	11-11-2004	Clear	58.40	129.10	510.20	898.21
2.	13-11-2004	Clear	52.92	138.24	611.25	912.16
3.	14-11-2004	Clear	49.18	120.42	468.45	874.24
4.	17-04-2005	Clear	56.25	118.27	532.56	848.95
5.	18-04-2005	Clear	61.15	142.05	876.84	1084.60
6.	19-04-2005	Clear	58.68	138.98	464.14	994.78
7.	15-09-2005	Rainy	9.59	35.11	81.20	158.20
8.	16-09-2005	Cloudy	14.28	45.80	116.60	199.90
9.	17-09-2005	Rainy	11.70	25.00	45.80	162.40

The minimum, maximum and average values of the four parameters at the five sites and the maximum, minimum and average values for each of the four parameters is presented in the table No 3.6 for comparison. (Fig.5 and 6)

Table 3.6 Minimum, maximum and average values of the four parameters at the five study sites and the maximum, minimum and average value for the each parameter during the study.

Sites	**Values**	**SO2**	**NOx**	**RSPM**	**SPM**
Bapat Camp	Minimum	6.52	16.02	64.50	172.80
	Maximum	67.14	181.89	687.04	1096.89
	Average	38.57	100.38	448.90	779.90
Shiroli Naka	Minimum	19.53	44.36	81.25	233.33
	Maximum	87.04	145.70	814.50	974.14
	Average	58.39	106.70	460.10	698.09
Gandhinagar	Minimum	9.06	21.27	84.16	112.49
	Maximum	86.98	144.20	898.99	961.48
	Average	47.66	90.13	405.26	602.68
Walivade	Minimum	6.38	30.68	33.33	64.53
	Maximum	20.76	68.32	290.00	448.96
	Average	13.49	50.14	135.40	275.79
Uchgaon	Minimum	9.59	25.00	45.80	162.40
	Maximum	61.15	142.05	876.84	1084.60
	Average	41.35	99.21	411.89	681.49
Minimum		6.38	16.02	33.33	64.53
Maximum		87.04	181.89	898.99	1096.89
Average		39.89	89.31	372.31	607.59

The knowledge of level of air quality is necessary, with an adequate margin of safety, to protect the public health, vegetation and property. As per the National Ambient Air Quality Monitoring Programme (NAAQMP) i.e. Central Pollution Control Board norms, the ambient air quality must be within the standard limits. The 24 hours average standard limit of ambient air quality for gases like SO_2 and NO_x is given in table No. 3.7. In the above table No. 3.6 one gas (NO_x) and the both the particulate matter parameter averages are above the prescribed limits. Only SO_2 parameter is within the limits in all the five study sites. The average SOx value was 39.89 with a maximum value at Shiroli Naka site about 87.04 and minimum of SOx value 6.38 at Walivade site.

The maximum values for SPM and RSPM were 1096.83 and 898.99 ug/m3 respectively. Whereas the minimum values for these parameters were 64.53 and 33.33 respectively. This clearly indicates the high level of air pollution at the brick kiln sites.

Table 3.7 CPCB national ambient Air Pollution permissible values for the Residential and Industrial area (24 hours monitoring)

Sr. No.	Pollutants	Industrial Area ($\mu g/m^3$)	Residential Area ($\mu g/m^3$)
1.	SO_2	120	80
2.	NO_x	120	80
3.	SPM	500	200
4.	RSPM	150	100

The seasonal variations in the four parameters during the three main seasons at the field sites are also given in the table no. 3.7(Fig 1 to 4)

Table: 3. 8 Seasonal average variations in the four parameters during the three main Seasons at the five field sites.

Sr. No	Parameter ($\mu g/m^3$)	Season	Bapat Camp	Shiroli Naka	Gandhi nagar	Walivade	Uchgaon
1.	**SO_2**	Winter	40.74	68.47	61.47	15.53	53.50
		Summer	65.43	82.92	72.01	17.69	58.69
		Monsoon	9.53	23.77	9.50	7.45	11.85
2.	**NO_x**	Winter	143.98	124.71	121.84	57.17	129.25
		Summer	136.10	140.13	113.22	59.06	133.10
		Monsoon	21.06	55.25	35.33	34.19	35.30
3.	**RSPM**	Winter	571.01	709.29	465.95	162.13	529.96
		Summer	652.12	569.68	655.69	201.73	624.51
		Monsoon	123.56	101.35	94.16	42.35	81.20
4.	**SPM**	Winter	1028.73	921.41	791.71	328.44	894.87
		Summer	973.57	919.44	879.55	357.30	976.11
		Monsoon	337.40	253.44	136.79	141.64	173.50

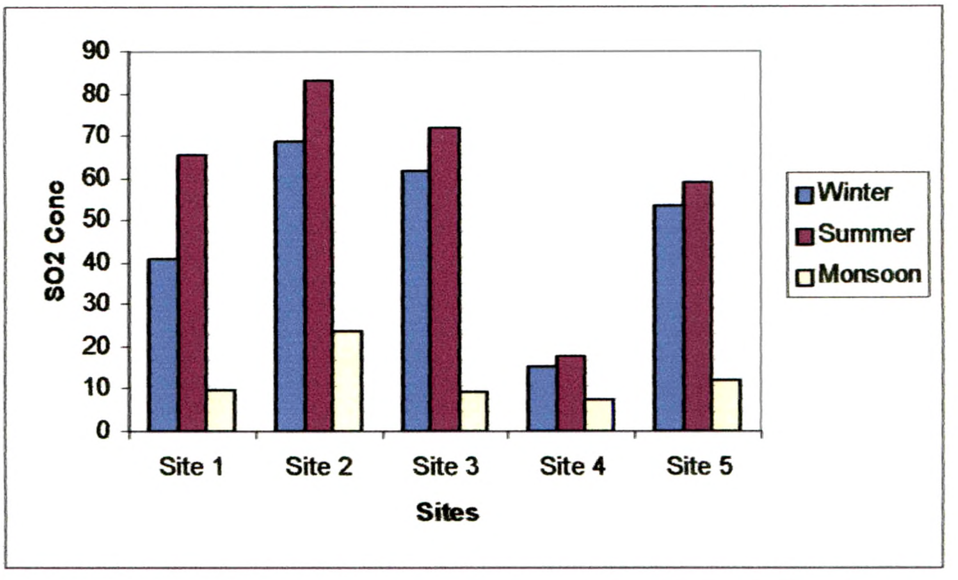


Fig 1: Changes in values of SO_2 during the three seasons winter, summer and monsoon at five different sites.

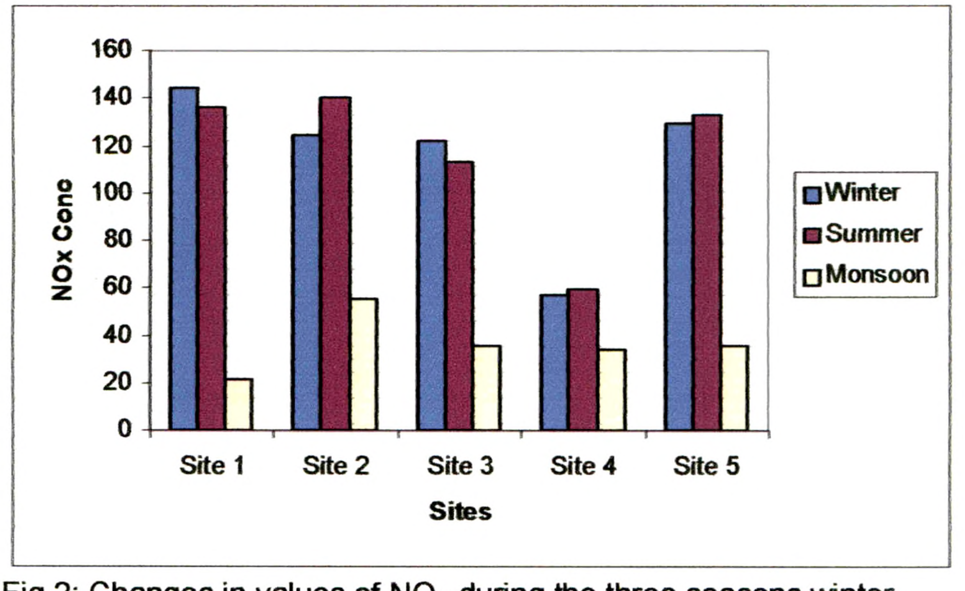


Fig 2: Changes in values of NO_X during the three seasons winter, summer and monsoon at five different sites.

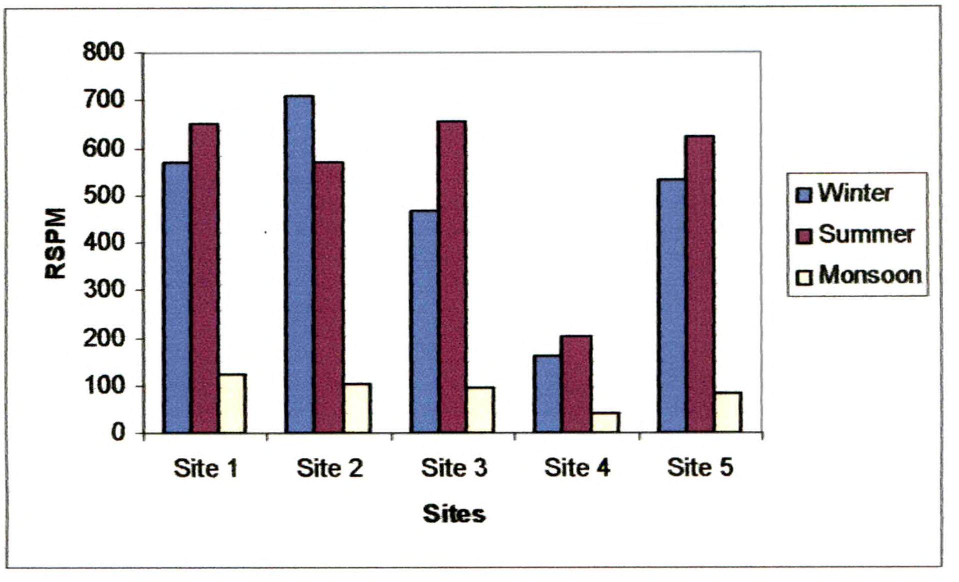


Fig 3: Changes in values of RSPM during the three seasons winter, summer and monsoon at five different sites.

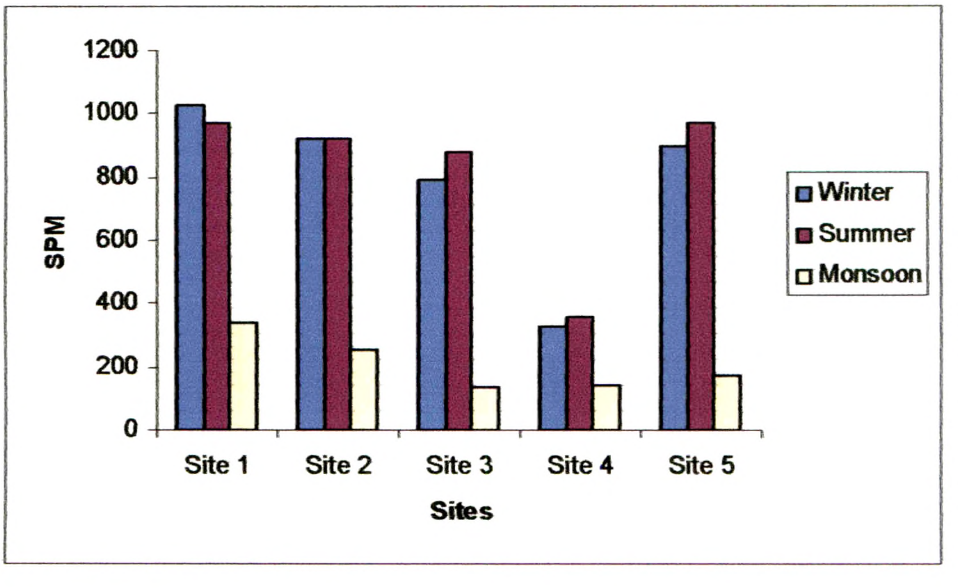


Fig 4: Changes in values of SPM during the three seasons winter, summer and monsoon at five different sites.

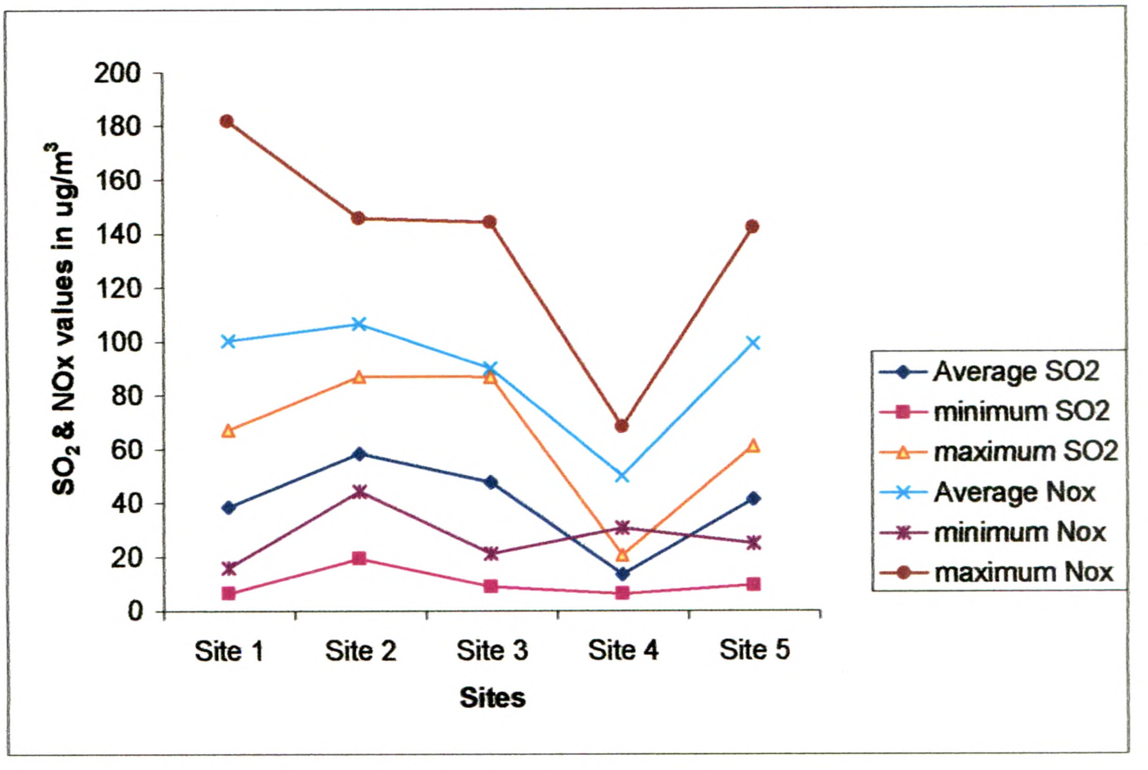


Fig 5: Showing comparison of SO_2 and NOx values I.e. Average, minimum and maximum at the five study sites.

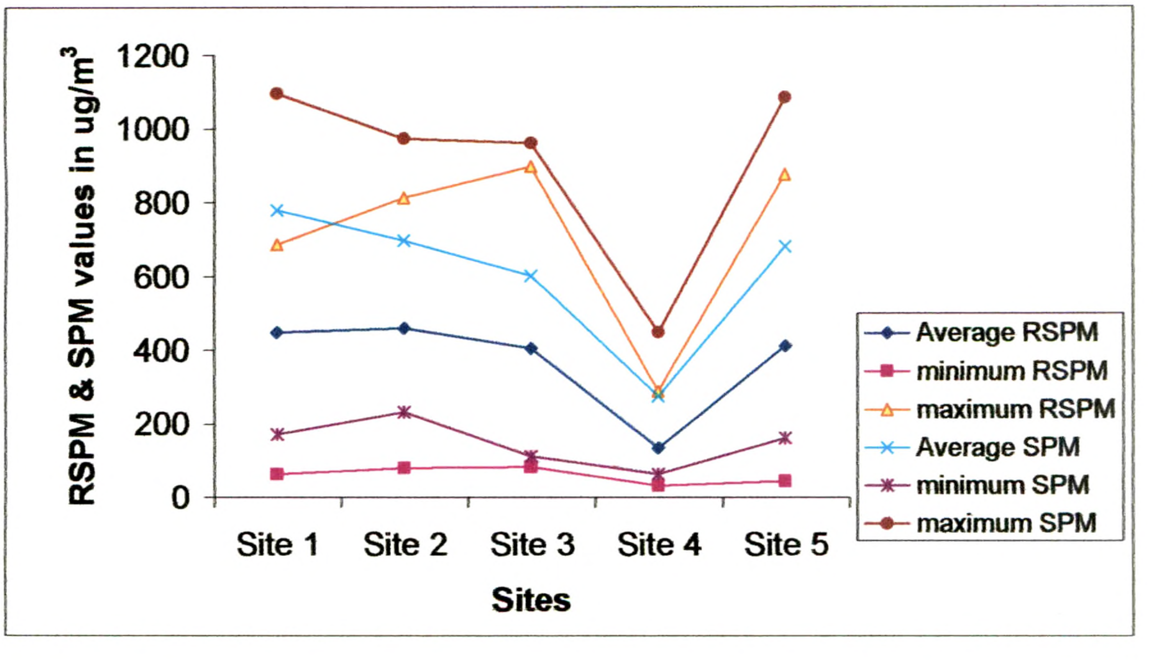
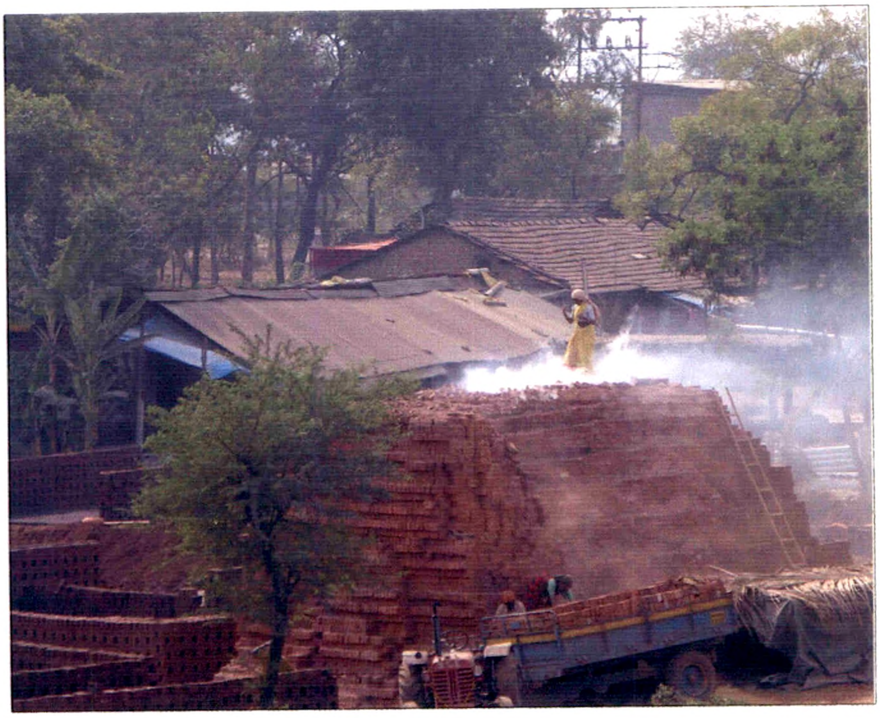


Fig 6: Showing comparison of RSPM and SPM values I.e. Average, minimum and maximum at the five study sites.

Plate IV



a) Brick kilns as air pollution hazard. Note a woman worker on the top of firing kiln. Notice proximity of houses (Uchgaon Site)

b) Suspended particulate matter and noxious gases is a potential threat to residents in the urban area (Uchgaon Site)

Air pollution due to brick kilns, has been known to cause serious occupational health hazards, and adverse effects on crops, orchards and buildings. Once the air monitoring data is collected, there is a further need to translate them into air quality ~~indicates~~. In the present investigation, to indices identify the major pollution parameters as well as their specific impacts near a brick kiln, the seasonal variations with different parameters in all study sites, ~~was~~ were analysed and it was observed that the winter and summer seasons results are more than monsoon season. Bad expression

3.3 Soil Quality Analysis results

Most of the economic activity that took place subsequent to the industrial revolution followed an 'open-ended' approach as regards flow of materials and energy in all production processes. The approach involved transformation of natural resources into useful products and returning the worn-out products and by-products or wastes of the production process back to the mother nature. It was assumed that the natural resources were infinite and could be harvested at will indefinitely. It had no concern whatsoever for conservation of natural resources and environmental quality and hence, led us to a situation where 'sustainable waste management' has become our highest priority today.

Although the high consuming societies of the developed world need to take lion's share of the blame and responsibility for the environmental damage, we in India cannot remain to be silent observers to the worsening ecology and therefore economy around. To resolve this apparent conflict between development and environment, hereafter, all governments, businesses and individuals will be required to move towards a framework where development (or growth!) becomes environmentally sustainable. This is the basis of the 'industrial ecology' concept. It aims to transform the 'open' system of production into one where material and energy flows are 'closed', i.e. all wastes and by-products get reused within the 'system' as a result of transfers among 'symbiotic' participating industries. Utilisation of waste materials in brick making is one good example of industrial ecology at work.

Topography and times are affecting on the soil formation. The chemical and mineralogical composition are more important properties, these are responsible for course of soil formation. The fertile soil contains the various nutrients, humus, minerals, which are essential for the plant growth. Also it contains the major components such as air 25%, water 25%, minerals 45% and organic matter 5%.

Man utilises the soil systems mainly for developing large scale agro-industrial based processes and production units. Brick industries create soil degradation because the soil is raw material for brick industries this, is to meet the ever growing needs of a rapid expanding urban society. In clay brick making, where fertile soil i. e. the clay is used, firebricks usually contain 30-40% aluminium oxide (Al_2O_3) and silicon dioxide 50%.

Table 3.9 The composition of raw clay, mixed material, and burnt Brick material, from Bapat Camp site.

Sr. No.	Parameter	Raw clay	Mixed material	Burnt brick
1	pH	7.61	7.62	7.92
2	Moisture (%)	18.07	17.57	0.98
3	Conductivity(Mhos/cm)	0.10	0.10	0.02
4	Water holding capacity (%)	65.69	65.72	31.05
5	Alkalinity (mg/l)	20.40	18.50	15.80
6	Organic Carbon (%)	1.07	1.26	0.4
7	Organic Matter (%)	1.84	2.17	0.68
8	Nitrogen (Kg/hact.)	292.00	275.00	78.60
9	Phosphorous (Kg/hact.)	339.90	330.80	108.65
10	Potassium (Kg/hact.)	282.70	282.00	143.70
11	Iron (ppm)	0.490	0.481	0.481
12	Lead (ppm)	0.134	0.131	0.31
13	Cobalt (ppm)	0.625	0.619	0.615
14	Copper (ppm)	0.076	0.073	0.073
15	Manganese (ppm)	0.664	0.662	0.660
16	Zinc (ppm)	0.058	0.058	0.057
17	Nickel (ppm)	0.051	0.049	0.049

Table 3.10 The composition of raw clay, mixed material, and burnt Brick material from Shiroli Naka site

Sr. No.	Parameter	Raw clay	Mixed material	Burnt brick
1	pH	7.68	7.68	8.10
2	Moisture (%)	10.80	10.01	0.97
3	Conductivity(Mhos/cm)	0.10	0.10	0.05
4	Water holding capacity (%)	65.75	64.89	28.90
5	Alkalinity (mg/l)	10.25	10.48	10.05
6	Organic Carbon (%)	1.03	1.05	0.24
7	Organic Matter (%)	1.77	1.81	0.41
8	Nitrogen (Kg/ha.)	328.50	216.00	90.80
9	Phosphorous (Kg/ha.)	323.0	315.30	132.40
10	Potassium (Kg/ha.)	290.78	290.25	140.30
11	Iron (ppm)	0.542	0.541	0.538
12	Lead (ppm)	0.376	0.374	0.374
13	Cobalt (ppm)	0.832	0.820	0.820
14	Copper (ppm)	0.039	0.036	0.036
15	Manganese (ppm)	0.619	0.615	0.615
16	Zinc (ppm)	0.086	0.082	0.089
17	Nickel (ppm)	0.081	0.071	0.075

Table 3.11 The composition of raw clay, mixed material, and burnt Brick material, from Gandhinagar site

Sr. No.	Parameter	Raw clay	Mixed material	Burnt brick
1	pH	7.60	7.62	7.82
2	Moisture (%)	19.48	19.05	0.72
3	Conductivity(Mhos/cm)	0.14	0.11	0.02
4	Water holding capacity (%)	66.48	66.55	21.98
5	Alkalinity (mg/l)	14.98	14.48	13.18
6	Organic Carbon (%)	0.98	0.92	0.19
7	Organic Matter (%)	2.61	2.58	0.98
8	Nitrogen (Kg/hact.)	218.00	212.00	65.78
9	Phosphorous (Kg/hact.)	252.20	248.10	101.58
10	Potassium (Kg/hact.)	352.00	348.10	115.20
11	Iron (ppm)	0.490	0.488	0.477
12	Lead (ppm)	0.410	0.371	0.360
13	Cobalt (ppm)	0.574	0.568	0.562
14	Copper (ppm)	0.073	0.061	0.061
15	Manganese (ppm)	0.661	0.598	0.595
16	Zinc (ppm)	0.042	0.042	0.036
17	Nickel (ppm)	0.051	0.048	0.048

Table 3.12 The composition of raw clay, mixed material, and burnt Brick material, from Waliwade site.

Sr. No.	Parameter	Raw clay	Mixed material	Burnt brick
1	pH	6.70	6.70	7.70
2	Moisture (%)	16.92	16.84	0.98
3	Conductivity(Mhos/cm)	0.13	0.13	0.02
4	Water holding capacity (%)	75.02	76.12	14.98
5	Alkalinity (mg/l)	15.00	14.00	13.70
6	Organic Carbon (%)	1.83	1.91	0.13
7	Organic Matter (%)	3.15	3.29	0.22
8	Nitrogen (Kg/hact.)	322.50	314.60	105.60
9	Phosphorous (Kg/hact.)	339.90	324.10	98.78
10	Potassium (Kg/hact.)	328.90	326.50	125.11
11	Iron (ppm)	0.432	0.431	0.430
12	Lead (ppm)	0.298	0.284	0.281
13	Cobalt (ppm)	0.698	0.665	0.665
14	Copper (ppm)	0.051	0.038	0.038
15	Manganese (ppm)	0.592	0.584	0.581
16	Zinc (ppm)	0.082	0.081	0.072
17	Nickel (ppm)	0.074	0.068	0.068

Table 3.13 The composition of raw clay, mixed material, and burnt Brick material from Uchgaon site.

Sr. No.	Parameter	Raw clay	Mixed material	Burnt brick
1	pH	7.50	7.60	7.80
2	Moisture (%)	18.07	17.65	0.98
3	Conductivity(Mhos/cm)	0.10	0.10	0.05
4	Water holding capacity (%)	65.69	68.04	28.70
5	Alkalinity (mg/l)	19.60	17.90	16.05
6	Organic Carbon (%)	1.65	1.97	0.37
7	Organic Matter (%)	2.84	2.84	0.39
8	Nitrogen (Kg/hact.)	329.00	327.00	73.00
9	Phosphorous (Kg/hact.)	328.00	322.00	129.00
10	Potassium (Kg/hact.)	300.00	289.00	278.10
11	Iron (ppm)	0.456	0.452	0.452
12	Lead (ppm)	0.292	0.289	0.284
13	Cobalt (ppm)	0.689	0.675	0.671
14	Copper (ppm)	0.018	0.014	0.014
15	Manganese (ppm)	0.504	0.502	0.497
16	Zinc (ppm)	0.072	0.069	0.069
17	Nickel (ppm)	0.061	0.052	0.051

Table 3.14 Average values for the entire study area for each parameter

Sr. No.	Parameter	Raw Clay	Mixed material	Burnt brick
1	pH	7.41	7.44	7.86
2	Moisture (%)	1.66	16.22	0.92
3	Conductivity(Mhos/cm)	0.11	0.108	0.03
4	Water holding capacity (%)	67.72	68.26	25.12
5	Alkalinity (mg/l)	16.04	15.07	13.75
6	Organic Carbon (%)	1.31	1.42	0.26
7	Organic Matter (%)	2.44	2.53	0.53
8	Nitrogen (Kg/hact.)	298.00	268.92	82.75
9	Phosphorous (Kg/hact.)	316.60	308.08	114.08
10	Potassium (Kg/hact.)	310.87	307.17	160.48
11	Iron (ppm)	0.48	0.47	0.47
12	Lead (ppm)	0.30	0.28	0.32
13	Cobalt (ppm)	0.68	0.66	0.66
14	Copper (ppm)	0.05	0.04	0.04
15	Manganese (ppm)	0.60	0.59	0.58
16	Zinc (ppm)	0.06	0.06	0.06
17	Nickel (ppm)	0.06	0.05	0.05

During the present investigations soil samples were collected from five different sites (depth roughly a feet below soil surface) located in various parts of seven villages around Kolhapur city, which supply soil for brick industry. Soil samples were collected from three different places at a single site, which were referred as the composite samples and further these were mixed to make a representative sample. It was ensured that the representative sample presented a cross section of the soil found in the vicinity of the brick industry. Altogether 17 physico-chemical parameters were studied to compare the changes that take place during the brick making process. The data was generated at all the five identified field sites of the study.

The actual values of all the physico-chemical parameters at each sampling site are given in Tables i.e. Bapat colony site analysis results are given in table-3.9, Shiroli Naka site in table- 3.10, Gandhinagar site data in table-3.11, Walivade site are in table- 3.12, Uchgaon site are in table-3.13. These results are given in the form of three categories i.e. raw clay analysis (Before making of Bricks), mixed material (During brick making process) and burnt brick (Complete brick).

The soil analysis results are discussed parameter wise as follows.

pH

pH is the measurement of the intensity of acidity or alkalinity and measure the concentration of hydrogen ions in Soil. Most of chemical and biological reactions occur due to significant changes of pH in soil. pH of soil gets drastically changed with time due to exposure to air, biological activity, temperature changes, disposal of domestic and industrial waste, seasonally variation in photosynthetic activity etc. Soil samples at every site show variations in pH values analysed before and after the brick making process.

The average pH value for the area was 7.4 (raw clay), 7.4 (mixed material) and 7.8 (burnt brick) with a maximum recorded value at Shiroli Naka site of pH 7.68, 7.44 and 7.86 respectively. Minimum of pH value 6.7, 6.7 and 7.8 at Walivade site for raw clay, mixed material and burnt brick analysis.

The standard of soil with high production potential is within the range 6.5 - 8.3. The majority of soils are slightly basic due to the presence of basic elements like sodium. In the present study pH at all sites and all categories of soil, ranged between 6.7 to 8.1. The results indicate that the soils used for brick making are good productive soils. It was also revealed that there was not much change in the pH values after burning soils for bricks.

Electrical Conductivity

Conductivity is the measurement of the capacity of substance or solution to conduct electric current. The conductivity and salinity of the soil are the main agents for nutrient growth, which is useful for crop production. The standard values for good crop production is divided into two category ies 1) Less than 0.2 - 0.5 (Mhos/cm) = Low conductivity and 2) Greater than 0.2 - 0.5 (Mhos/cm) = High conductivity.

As per the present investigation, the average conductivity value for soil was 0.114 (raw clay), 0.108 (mixed material) and 0.032 (burnt brick)mmhos/cm found for all the study sites. Electrical conductivity of soil samples collected from the five villages at different sites ranged between minimum of 0.1 mhos/cm to maximum of 0.14 mhos/cm. The conductivity values of soil decreases after the making of brick i.e. burnt brick analysis than the raw clay analysis. It is an important indicator to check the salinity of soil and determining the suitability of soil for agricultural purposes. Any rise in the electrical conductivity of soil indicates pollution. However, In this study all conductivity values are within the limits. (Tables 3.8 -3.13 (Fig. 7))

Nitrogen, Phosphorus and Potassium (NPK)

NPK are essential nutrients for plant growth and more percentage of NPK indicates that the higher fertility of soil. The source of the nutrients can be found in larger quantities in sewage also. The NPK values were estimated from the soils in the study area, before and after the making of bricks. It was revealed that the raw soil contains maximum amount of nitrogen, phosphorous and potassium, which was slightly reduced after mixing other materials before brick making.(Plate III (b)) Burning of bricks drastically reduced the values of NPK as can be noticed from the Tables 3.8 -3.13 and figure no 10 –12.

The average nitrogen values for all the sites were 298 kg/ha in raw clay, 268.92 kg/ha in mixed material and only 82.75 kg/ha in burnt brick. The minimum value of raw clay, mixed material and burnt brick was 218.0 kg/ha, 212.0 kg/ha and 65.78 kg/ha at Gandhinagar site respectively. The maximum values of nitrogen was 329.0 kg/ha, 327.0 kg/ha at Uchgaon, and 105.6kg/ha at Walivade observed in raw clay, mixed material, burnt brick respectively. (Table 3.8 -3.13 and Fig. 10). The lowest value at Gandhinagar could be because it is a residential area and gets soil from neighbouring non agriculture lands.

The average phosphorus value for all study site was 316.6 kg/ha in raw clay, 308.06 kg/ha in mixed material and 114.08 kg/ha in burnt brick. The minimum of 252.2 kg/ha in raw clay, 248.1 kg/ha in mixed material at Gandhinagar site and at Walivade site minimum of burnt brick was 98.78 kg/ha. the maximum values were reported 339.9 in raw clay, 330.8 in mixed material and 132.4 in burnt brick . (Table 3.8 -3.13 ,Fig.11)

The maximum values for potassium were 352.0 kg/ha at Gandhinagar site, 348.1 kg/ha at Bapat camp site, 278.1 kg/ha at Gandhinagar site while minimum values for 282.7 kg/ha, 282.0 kg/ha at bapat camp, 115.2 kg/ha at Gandhinagar for both the sets i.e. raw clay,

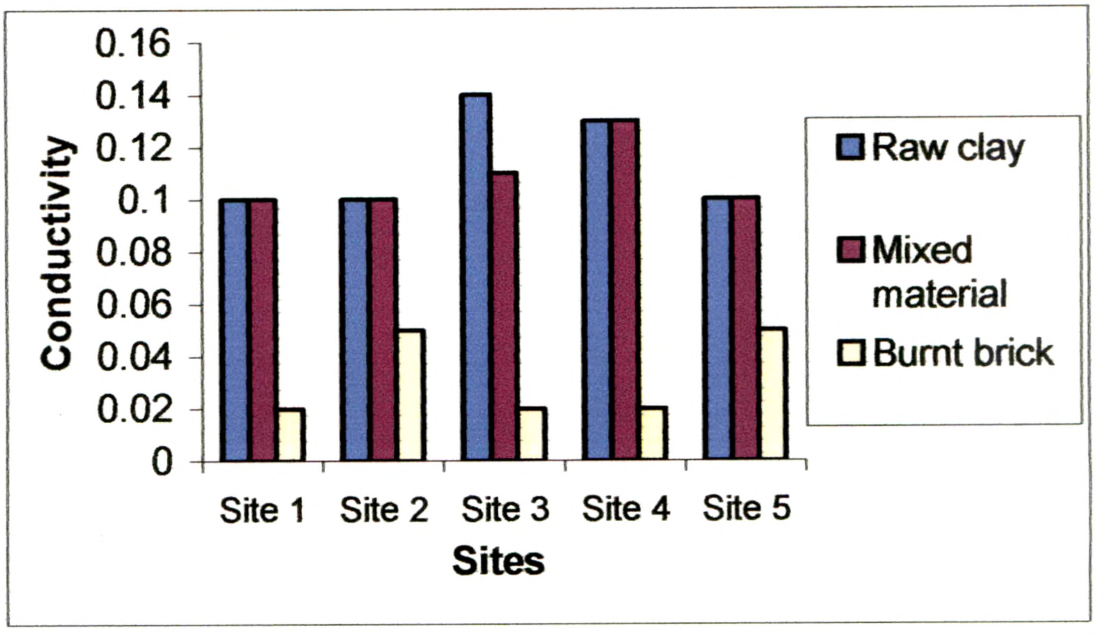


Fig 7: Changes in Conductivity in the raw clay, mixed material and burnt brick during brick making process at the five study site.

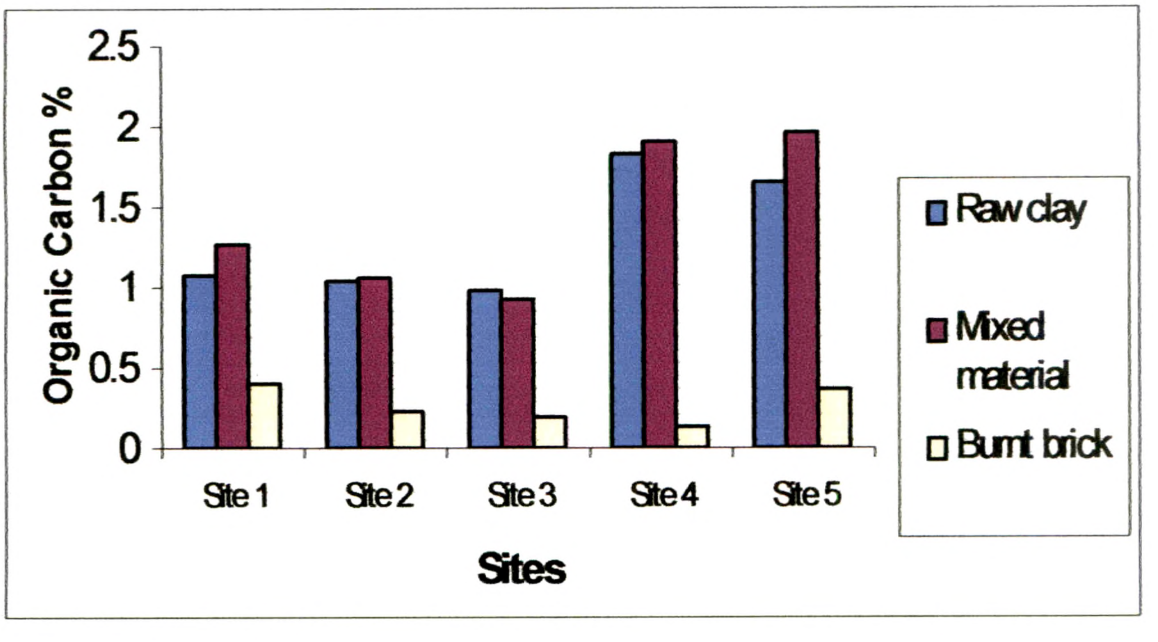


Fig 8: Changes in Organic carbon (%) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

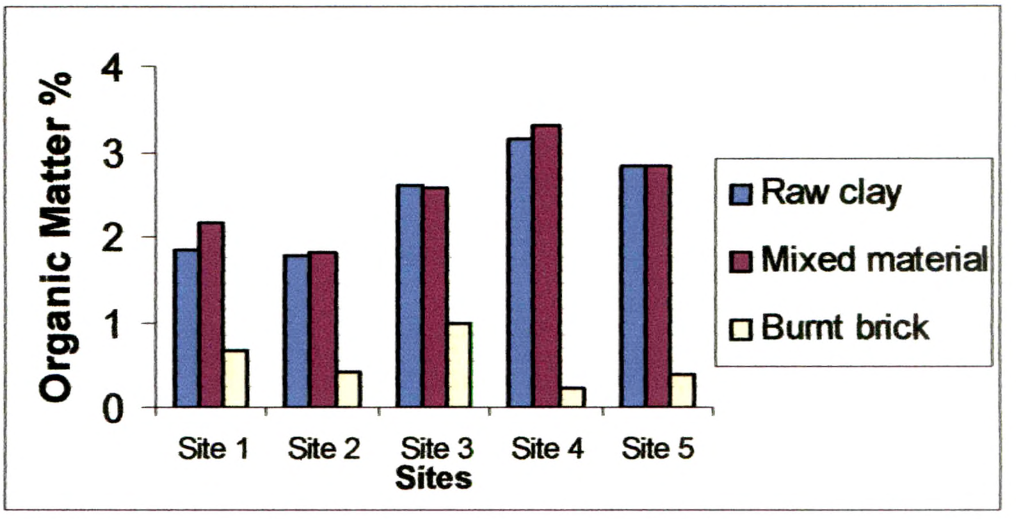


Fig 9: Changes in Organic matter (%) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

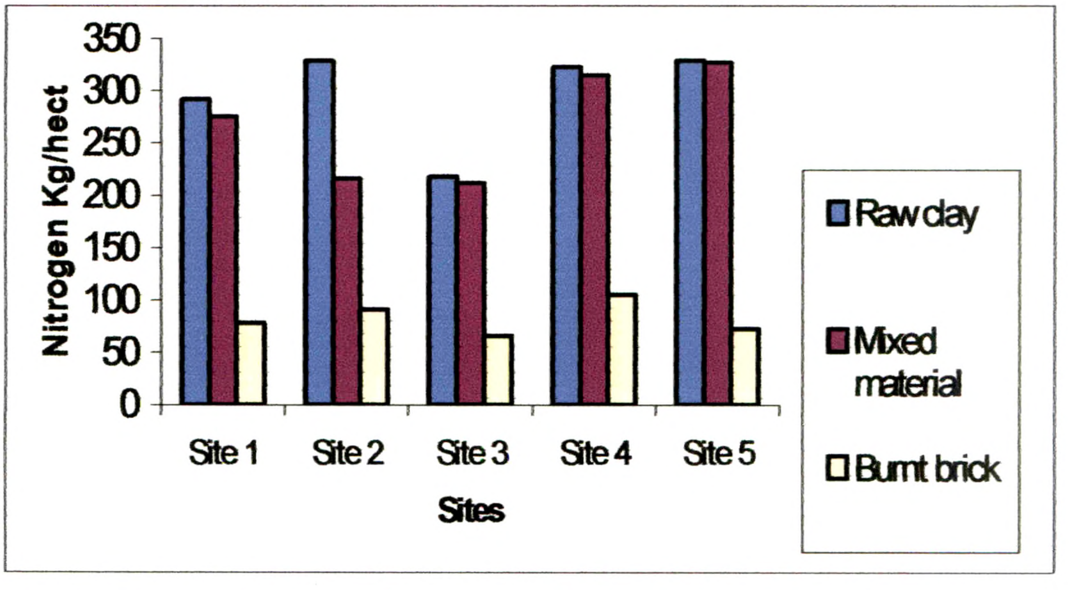


Fig 10: Changes in Nitrogen kg/hect in the raw clay, mixed material and burnt brick during brick making process at the five study site.

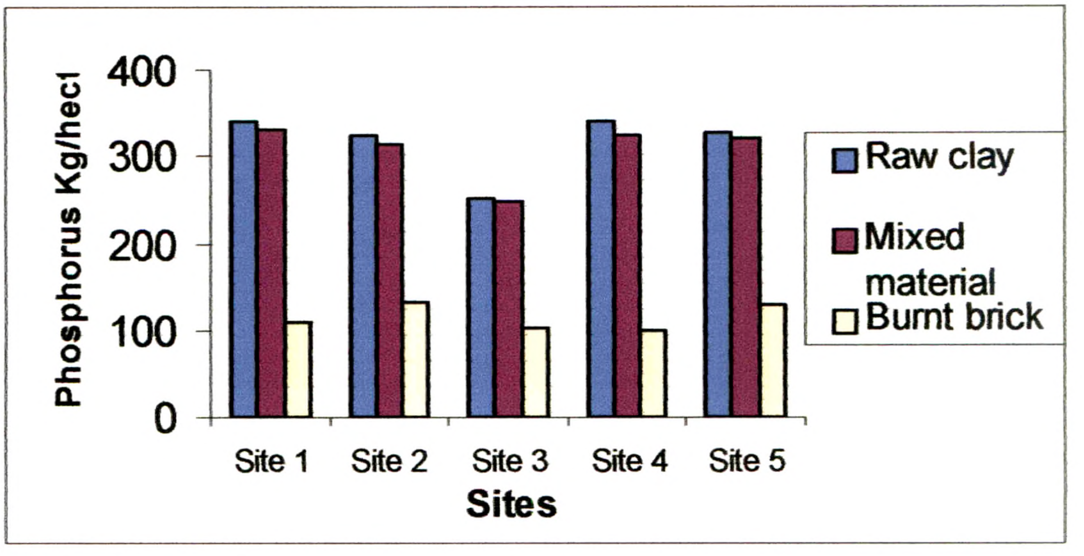


Fig 11: Changes in Phosphorus kg/hect in the raw clay, mixed material and burnt brick during brick making process at the five study site.

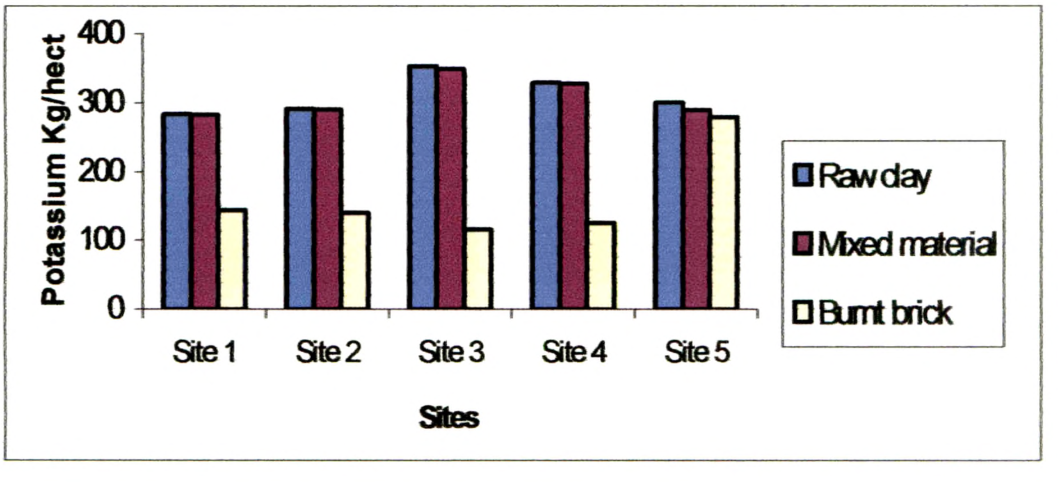


Fig 12: Changes in Potassium kg/hect in the raw clay, mixed material and burnt brick during brick making process at the five study site.

added mixed material, and burnt brick respectively. The average for this was 310.87 kg/ha, 307.17 kg/ha, and 160.48 kg/ha in raw, mixed and burnt brick (Table 3.8 -3.13, Fig. 12)

Organic Carbon and Organic Matter

Organic carbon and matter plays a vital role in the productivity and conditioning of soils. It serves food for soil bacteria and fungi. The average value of organic carbon was 1.312% in raw clay, 1.422% in mixed material, 0.266% in burnt brick. Maximum values of raw clay were 1.83% at Gandhinagar site, 1.97% in mixed material at Uchgaon site and 0.40% in burnt brick at Bapat camp site. The minimum values of organic carbon was 0.13% at Walivade site in raw clay, and at Gandhinagar site 0.98%, and 0.92% in mixed material and burnt brick respectively. (Table 3.8 -3.13, Fig. 8)

Normally organic matter percentage over 1% is considered good for plant production. In the present study, it is found that the value of organic matter in burnt brick was less than raw clay and mixed material. The average values of organic matter was 2.442%, 2.538%, 0.536% in raw clay, Mixed material and burnt brick respectively. The ranged values of organic matter from maximum was 3.29 % in mixed material to minimum was 0.22 % at Walivade site. (Table 3.8 -3.13, Fig. 9).

Heavy metals

Heavy metals usually present in trace amounts in natural waters and soil but many of them are toxic even at very low concentration. They are those having a density more than five times higher than that of water and directly or indirectly effect on soil also. Their concentration increases in soil due to addition of industrial wastes and agro-chemicals.

During the investigations 7 heavy metals were studied from the soils in the identified study sites. The recorded values of the seven heavy metals

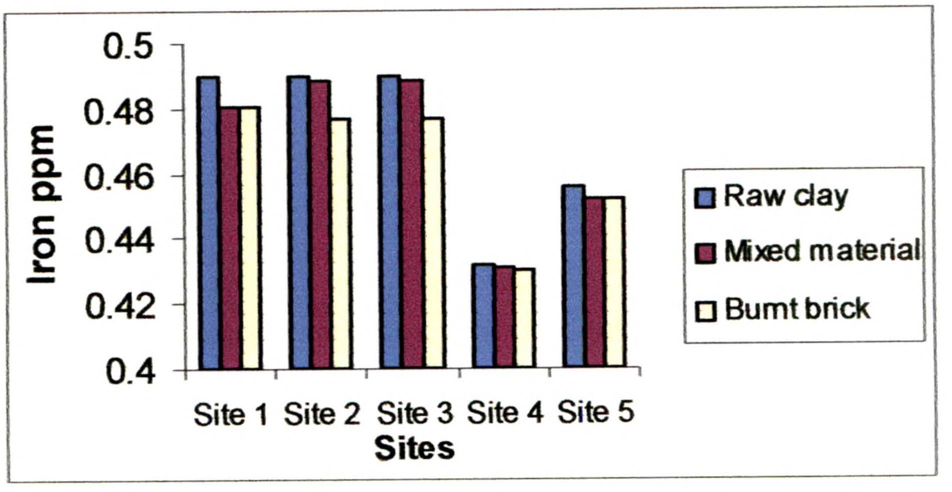


Fig 13: Changes in Iron (ppm) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

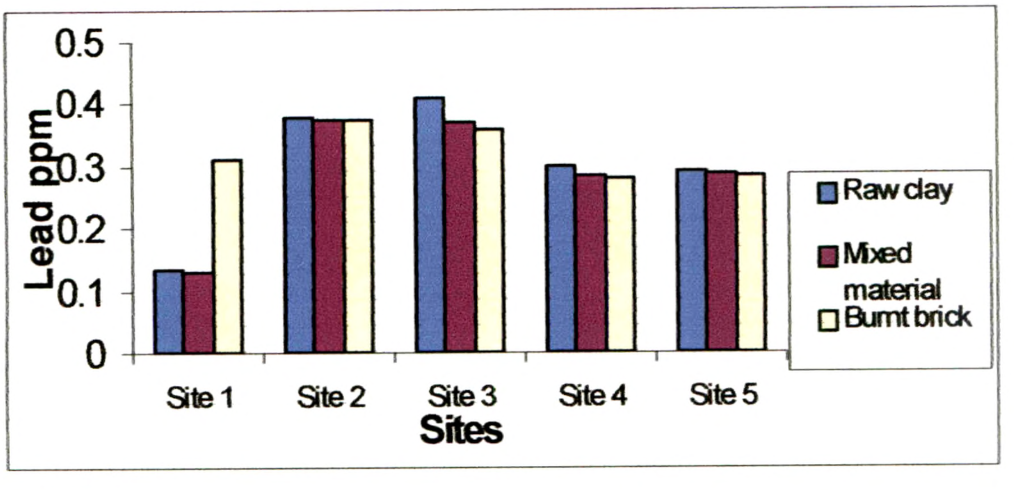


Fig 14: Changes in Lead (ppm) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

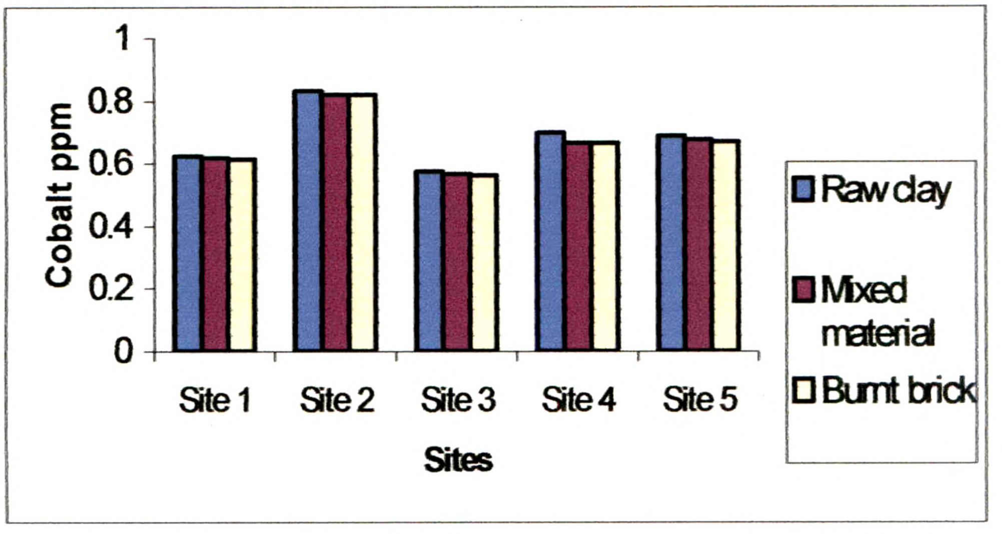


Fig 15: Changes in Cobalt (ppm) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

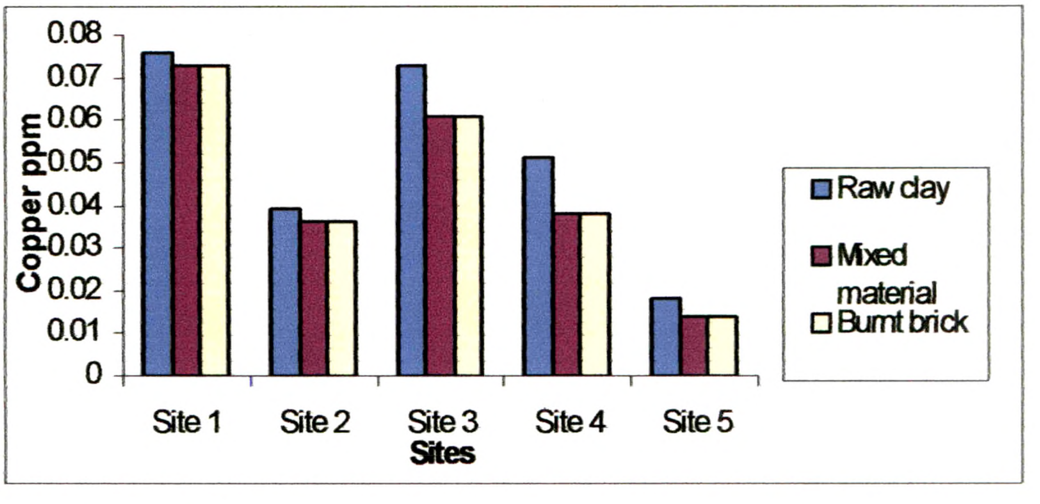


Fig 16: Changes in Copper (ppm) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

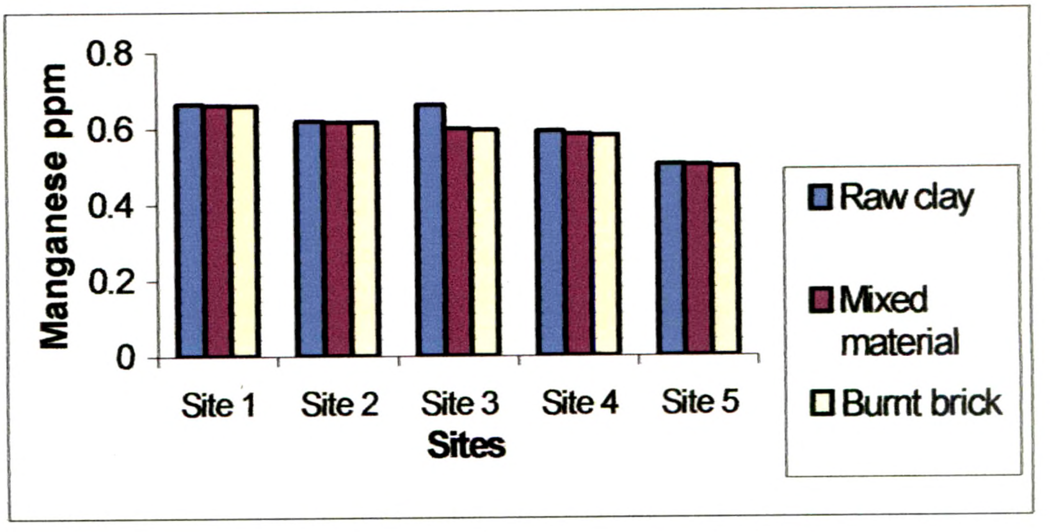


Fig 17: Changes in Manganese (ppm) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

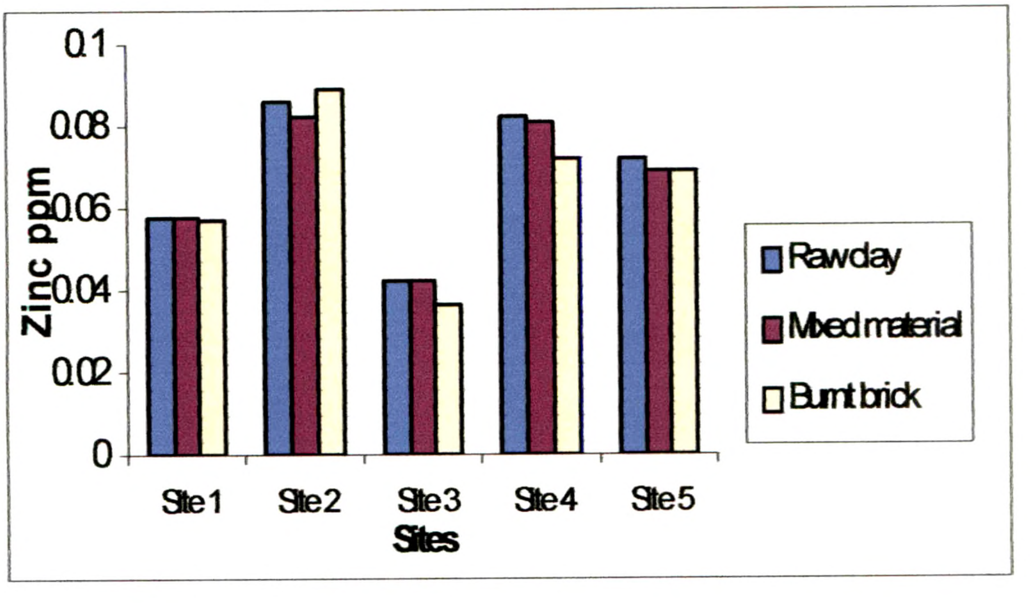


Fig 18: Changes in Zinc (ppm) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

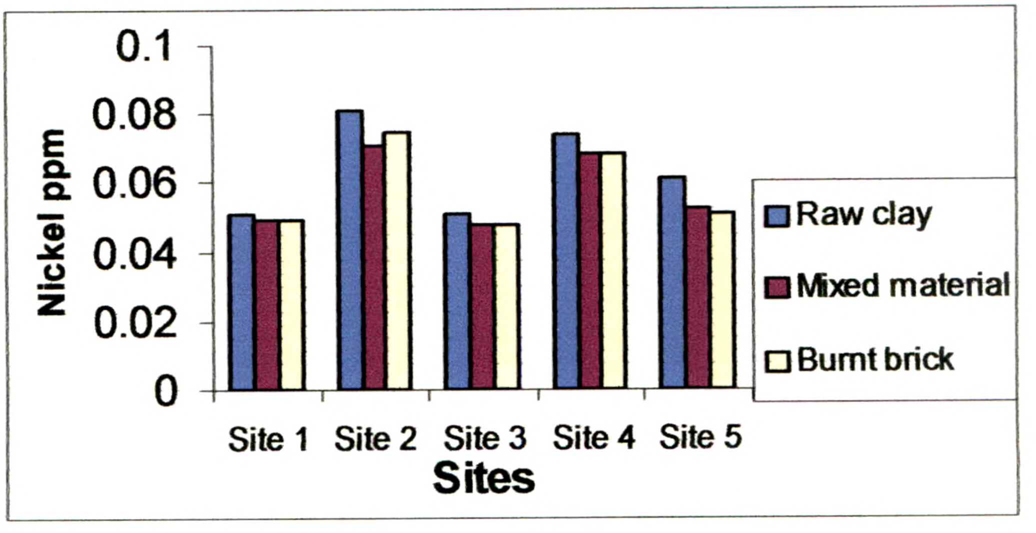


Fig 19: Changes in Nickel (ppm) in the raw clay, mixed material and burnt brick during brick making process at the five study site.

for raw clay, mixed material, burnt brick are shown in Table 3.8 -3.13 and Figure 13 to 19.

Similar ? Comprising the seven heavy metal, highest average value for cobalt was 0.683ppm in raw clay, 0.669ppm in mixed material and 0.666 ppm in burnt brick. The minimum and maximum values for iron content was 0.432ppm at Walivade and 0.542ppm at Shiroli naka in raw clay, 0.431ppm at Walivade, and 0.541at shiroli naka ppm in mixed material. Also in burnt brick maximum value was recorded at shiroli naka (0.538ppm) and minimum value at Walivade site (0.43ppm). After cobalt, manganese parameter shows second highest values in all category of the soil. The maximum value recorded was 0.664 ppm in raw clay and 0.66 ppm in mixed material and 0.66ppm in a burnt brick. As compared to the other parameters, heavy metal showed slightly ~~or no~~ change in concentration in all the types of ~~study~~ soils studied.

3.3 Cost - Benefit Analysis :

Surface soil from cultivable waste lands, rice fields, sugarcane fields and alluvial clay (called 'Poyta' in Marathi) from banks or rivers beds, and silt from ponds and percolation tanks are used as raw materials for bricks. If soil is procured from privately owned lands, in addition to the usual cess Royalty and Cease, payment to landlords varies between Rs. 50.00 and Rs. 150.00 per 200 cft truck load. The Government of Maharashtra has recently exempted entrepreneurs belonging to Kumhar Caste (potter) from payment of Royalty and Cease. cess

A family of two to four persons - husband, wife and one or two children - can mould up to 1,500 nos. 9" x 4" x 3" size bricks and 750 nos. 9" x 6" x 4" size bricks per day including raw-mix preparation, shaping and setting operations. Coal powder / ash, chopped bagasse / husk and grog (burnt powdery material from brick kilns) is mixed with clay in the desired proportion to impart the right plasticity and burnability to the raw-mix. For this work, contract labour is paid Rs. 80.00 to Rs. 135 .00 per 1,100 nos. 9" x 4" x 3" size bricks, and double the amount for 9" x 6" x 4" size bricks.

During monsoon, moulders are ' booked ' for the oncoming season by paying Rs. 5,000 to Rs. 15,000 as advance per family. Moulders normally come from draught-prone areas in Jalgaon and Beed Districts in Maharashtra and Chhattisgarh (M.P.), vijapur (Karnataka), etc. Districts adjoining Maharashtra. 'B' or 'C' Grade steam coal from WCL's coal mines in Chandrapur and Yavatmal Districts is primarily used as fuel in firing open clamps. Its present landed cost varies in the range of Rs. 1,200.00 at Nagpur and Rs. 2,600.00 at Pune. Undersize material in grit or powder form rejected by thermal power stations is also used, its destination price varying between Rs. 1,000.00 to Rs. 1,800.00. Coal ash (i.e. partially burnt coal from grate-type boilers, railway engines, etc.) is used as a supplementary fuel. After screening the coal ash, the fines are mixed with clay and the coarser part is used as fuel for firing the clamp from its sides.

The proportion of coal powder / ash mixed with clay may vary between 75 and 120 kg per 1,000 dry bricks, while that of steam coal used in the clamp may vary between 100 and 150 kg per 1,000 bricks. Steam coal, refinery / oil industry waste, firewood, rice husk, etc. are used as fuels in Moving Chimney Kilns. Although IS: 1077-1992 recommends use of 'Modular' bricks (of 7.5" x 3.5" x 3.5") or 'Non-Modular' bricks (of 9" x 4.25" x 2.75"), none of the manufacturers in Maharashtra adopts this size.

The 9" x 4" x3" size bricks are called 'full size' bricks. Length of an individual hand-made brick varies between 8.5" and 9", width 3.5" and 4" and height 2.5" and 3". These smaller bricks are called 'cut size' ones. 9" x 6" x 4" bricks, which are called 'double bricks', are of recent origin and are gaining popularity in urban markets day by day. Bricks fired in open clamps and moving chimney kilns are only classified in two categories - saleable and rejects (i.e. under burnt or over burnt). Breakage and rejections during clamp firing are upto 20 per cent.

Due to the peculiar quality of soil in Maharashtra, which needs addition of higher proportion of coal powder, ash, grog to reduce its plasticity and improve burnability, bricks in Maharashtra are generally more porous and low in strength (usually less than 35 kg / cm^2), as compared to the ones in the North and North-East India. Bricks of higher heights fetch higher prices. The present 'destination' rates of 'cut size' bricks in Maharashtra vary in the rage of Rs.800.00 and Rs.1,800.00 per 1,000 nos. 'Double bricks' are sold within a range of Rs. 2,200.00 to Rs. 3,400.00 per 1,000 nos. Bricks are viably sold within an average 'marketable radius' of about 100 kilometres from the point of their manufacture. A 10 tonne truck normally accommodates 2,000 'double bricks', or 3,000 'full size' or 4,000 to 5,000 'cut size' bricks. The present Sales Tax in the State is 8%.

It is interesting to see what motivates a farmer to sell his fertile farm soil for brick making as one time transaction against sustained agricultural income.

An attempt is being made to calculate comparatively the opportunity cost of the fertile soil for a) making of brick b) for agriculture purpose. We assume that one acre land is used.

• 1 acre.	4960 trolleys soil.
• Only fertile soil.	460 trolleys.
• Furnace can be established with this soil.	10 of 50,000 bricks.
• Number of bricks can be prepared in 1 acre.	5,00,000 bricks.
• Cost.	Rs. 3,98,500/-

The cost of bricks as given below : For 5,00,000 bricks.

A)	Cost of raw bricks. (Soil, levelling, Baggas, Tax etc.)	Rs. 53,500/-
B)	Cost of furnace (coal, powder, piece of wood etc)	Rs. 1,66,000/-
C)	Labour charges. (for digging, bringing baggas, raw bricks, arranging of structure of furnace)	Rs. 1,77,000/-
	Total cost. ..	**Rs. 3,98,500/-**

For agriculture:

Example-1 :– Sugarcane in a year : Amount of Sugarcane in

• 1 acre.	50 tonnes
• Cost	Rs. 30,000/-
• Price	Rs. 57,000/-
• Benefit	**Rs. 27,000/-**

Example-2 : Jawar in a year :

• Amount of Jawar in 1 acre.	15 Quintal
• Amount of straw -same land	1,500 bundles
• Cost	Rs. 3,500/-
• Price – Jawar	Rs. 11,500/- (Rs. 900/-/Quintal)
• Straw	Rs. 4,500/- (Rs. 300/- / 100 bundles)
• Benefit	**Rs. 14,500/-**

Justification :

If a farmer sells the soil for brick making then, ~~I~~ he gets around Rs. 1,86,000/- and this would be his only one time income in one year. If a farmer sells the same land soil for 6 year than the farmer can get a total income of Rs. 11,16,000/-. After the 6 feet of depth, ~~on~~ the farmer can sell his land provided there is a buyer for the degraded land. On the contrary if the same land is used for sugarcane cultivation for six years then the total income would be Rs. 1,92,000/- and Jawar for six years then Rs. 87,000/- only. .

Thus, we can see that the income from sugarcane and jawar for six years is less than the income from sell of soil bricks. Here, the advantages considered by the farmers is that once the soil for bricks is sold he still can his sell ~~is~~ land for other purposes, particularly for the new urban demands from the urban fringe areas. However, the ecological loss and long term agricultural loss is phenomenal. Similarly ~~we~~ the soil can be used again and again, if its productivity is retained for agricultural production thus there is no permanent long and sustained agriculture, as there is no substitute to food production, just as in the case of the tale of rabbit and tortoise!!! Therefore, farmers obviously prefer to sell the soil rather than using it for agriculture; but it is unwise to do it from the environmental, societal and future point of view.

CHAPTER - IV