



## Quantifying The Cement Air Pollution Related Human Health Diseases In Ariyalur District, Tamilnadu, India.

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### Abstract

This study examines the significant different in seasonal variations of air pollutant concentrations of Particulate matter, SO<sub>2</sub>, NO<sub>2</sub>, CO and metals like chromium, lead and nickel collected over five regions in Ariyalur district due to cement industries. Occupational cement dust exposure has been associated with an increased risk of respiratory diseases in workers who are employed in cement industries are exposed to cement dust for long periods. Almost all the persons affected by mild type were reversible to normalcy after inhalation of bronchodilators; severe form of bronchial asthma and COPD response to moderate state. The high morbidity and mortality among the cement industry workers and dwellers in nearby industrial areas may be due to elevated levels of urinary and blood chromium and lead levels and resulting from increased air levels of chromium and lead at the work place. This paper present air pollutants (suspended particulate matter, sulphur dioxide and oxide of nitrogen) emitted from Ariyalur cement plant and they may produce harmful effects on human health and his environment. This study was undertaken to investigate the quality of air in Ariyalur . Cement air pollution is rapidly becoming an environmental problem of public concern worldwide. It can influence public health and local or regional weather and climate. All the data were collected for a study period at five different locations (Govindapuram, Thamaraikulam, Keelpaluvur, Alathiyur, Thalavai.). In the present study at Ariyalur city, Primary pollutants such as SO<sub>2</sub> and NO<sub>x</sub> were found within the standard value and SPM exceeding the standard value prescribed for

residential and rural uses by CPCB, New Delhi. Maximum concentration of Suspended particulate matter, Sulphur dioxide and Oxide of nitrogen is found during winter months, moderate during summer and minimum during monsoon months indicate marked seasonal variation of pollutants under present investigation. Present study determines association between cement air pollution on one hand and occurrence of human health diseases on other hand. A questionnaire based survey was conducted to collect the data for incidence of air pollution linked diseases among the people of sampling sites. Result determine the maximum incidence of respiratory diseases (such as tuberculosis, bronchitis, cough, asthma etc.) compare to other diseases among the affected people.

### **Keywords:**

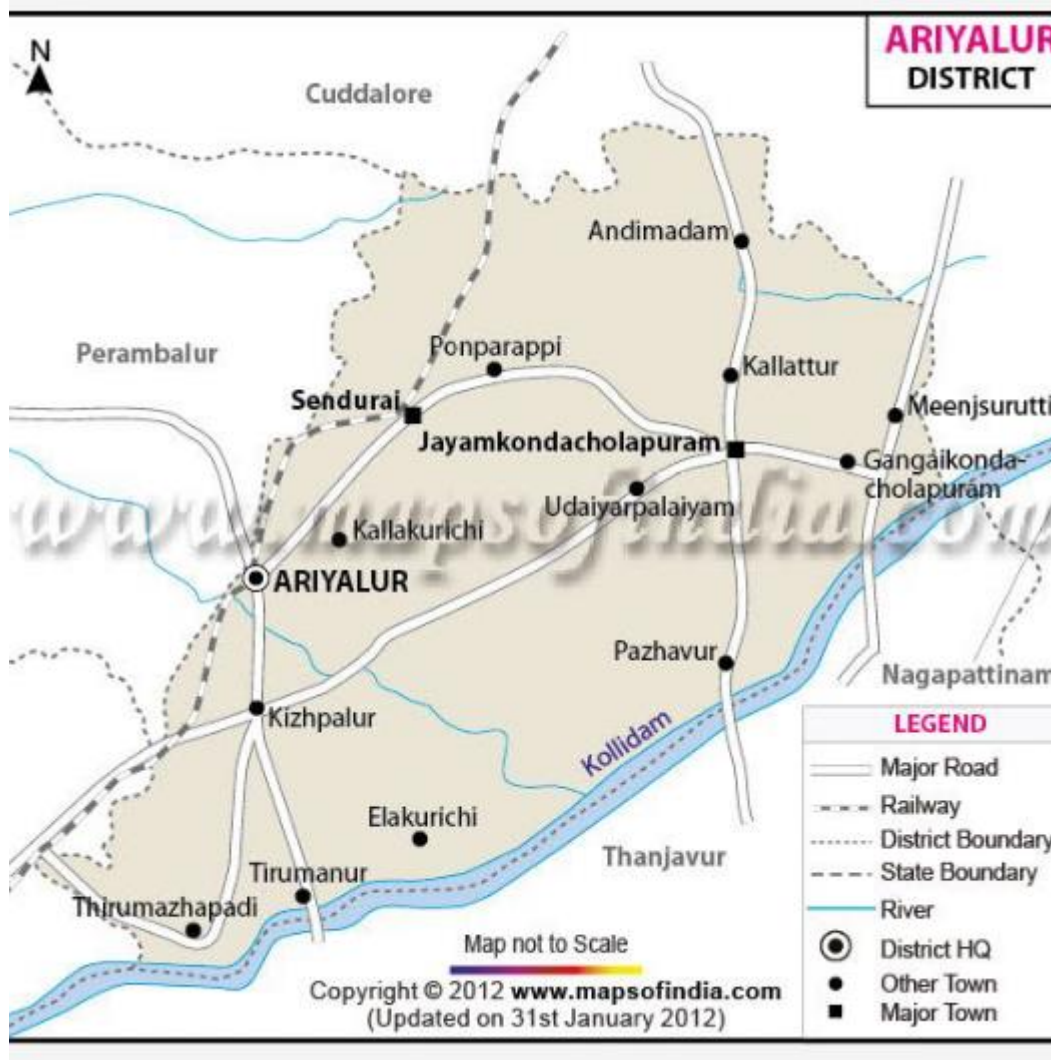
**Ambient air pollution, human health diseases, Ariyalur cement plant.**

### **Introduction**

This epidemiological study examined the atmospheric pollution and severe diseases created by some cement disposal facilities in the Ariyalur district of Tamil Nadu. Cement industry is considered as a major pollution problem on account of dust and particulate matter emitted at various steps of cement manufacture. Cement dust consists of many toxic constituents such as particulate matters, SO<sub>2</sub>, NO<sub>2</sub> and CO and metals like nickel, cobalt, lead, and chromium. Air pollution is a mixture of substances, including volatile organic compounds, nitrogen oxides, sulphur dioxide, carbon monoxide and particulate matter. The environment is an integral part of human life, the quality of which plays a critical role in human health. Air pollution has its own peculiarities, due to its transboundary dispersion of pollutants over the entire world. Therefore the study on air pollution and related impacts on human health have a special consideration today. Air pollution is related to serious health problems such as respiratory diseases, gastrointestinal diseases, blood pressure diseases, dental diseases, eye diseases, skin diseases and other diseases. The causal relationship of mortality and morbidity with air pollution has been found significant for a range of concentration levels.

Vehicular emission is responsible for higher levels of air pollutants like SPM, RSPM, SO<sub>2</sub>, NO<sub>x</sub> and other organic and inorganic pollutants including trace metals and their adverse effects on human health and environmental health. Air pollution continues to receive a great deal of interest worldwide due to its negative impacts on human health and welfare. Several studies reported significant correlations between air pollution and certain diseases including shortness of breath, sore throat, chest pain, nausea, asthma, and bronchitis and lung cancer. One of the most critical impact of cement manufacturing is the dust generated during transport, storage, milling, packing etc. Atmospheric dust is an important source of air pollution particularly in dry climates. Mineral dust contains high concentrations of many metals known to have toxic effect not only on plants and animals but also on humans. Many international studies have

shown that there are serious health risks associated with air pollution. According to the World Health Organization (WHO), air pollution is responsible for increase in outpatient visits due to respiratory and cardiovascular diseases, hospital admissions and mortality. This paper present the qualitative impairment of ambient air due to sulphur dioxide, oxides of nitrogen and suspended particular matter which is emitted from Ariyalur cement factory in Ariyalur city. The ill effect of these ambient air pollution on human health such as respiratory diseases, gastrointestinal diseases, blood pressure diseases, dental diseases, eye diseases, skin diseases and other diseases. Cement industry is a potential anthropogenic source of air pollution. It is a major contributor to dust, nitrogen oxides (NO<sub>x</sub>), sulfur oxides (SO<sub>x</sub>), and carbon monoxide (CO) in metropolitan areas. Furthermore, it contributes about 5% of the global CO<sub>2</sub>, the famous green house gas. In cement industries, dust is emitted from stock piles, quarrying, transportation of raw materials, kilns operation, clinker cooling and milling.



## Material and Methods ....

Ariyalur is situated in the part of Tamilnadu state. Ariyalur is developed city of cement factory. It is situated 11.8° latitude and 79.4° longitude on National highway NH-226 and along the railway station also available. For the present study five sampling sites were selected in Ariyalur city such as Govindapuram, Thamaraikulam, Keelpaluvur, Alathiyur, Thalavai.. Monthly SPM and gaseous pollutant such as SO<sub>2</sub> and NO<sub>x</sub> were monitored by respirable dust sample (Envirotech model APM 460 BL-441) for 8 hour in a day as per the standards of central pollution control boards (India). Suspended particulate matters were collected on the dust cup where as gaseous pollutants (SO<sub>2</sub> and NO<sub>x</sub>) collected in sodium tetrachloromercurate and sodium hydroxide arsenate solution respectively. After sampling the samples were analyzed as per methods described in manual of RDS and NEERI. AQI (air quality index) is then calculated with the concentration values using the following equation.

$$AQI = \frac{1}{3} \times (ISPM / SSPM + ISO_2 / SSO_2 + INO_x / SNO_x) \times 100$$

The questionnaire based survey was conducted in Ariyalur of evaluation of diseases due to air pollution.

## Results and Discussion

The present study indicates the air pollutants concentrations and its impact on human health at five monitoring sites of Ariyalur city.

### Seasonal variation of ambient air pollution:

It is observed from the table -1, that the concentration of air pollutants such as suspended particulate matter, sulphur dioxide and nitrogen oxides for three seasons of the study period. Result determined the SPM concentration is the ambient air of all sampling sites varied between 281.07 µg/m<sup>3</sup> to 342.25µg/m<sup>3</sup>, 322.29µg/m<sup>3</sup> to 387.20µg/m<sup>3</sup> and 172.25µg/m<sup>3</sup> to 213.03µg/m<sup>3</sup> during summer, winter and monsoon months respectively, sulphur dioxide concentrations were recorded in the range of 28.21µg/m<sup>3</sup> to 38.17µg/m<sup>3</sup>, 34.36 µg/m<sup>3</sup> to 52.69µg/m<sup>3</sup> and 15.13µg/m<sup>3</sup> to 28.78µg/m<sup>3</sup> at five sampling sites during summer, winter and rainy season respectively. At all monitoring site NO<sub>x</sub> concentration were recorded in the range of 35.27µg/m<sup>3</sup> to 42.75 µg/m<sup>3</sup>, 41.20µg/m<sup>3</sup> to 48.72 µg/m<sup>3</sup> and 21.72 µg/m<sup>3</sup> to 28.02µg/m<sup>3</sup> during summer, winter and monsoon seasons. Highest concentration of SPM, SO<sub>2</sub> and NO<sub>x</sub> was

recorded during winter, moderate in summer and lower in monsoon months at all sampling stations. In summer months the low humidity and high winds facilitate concentration of SPM in the

ambient air. During winter months, due to calm condition there is trapping of all atmospheric pollutants near the ground level. Falling rain drops are known to prompt a washing out; solid material is dragged towards the ground and the air is thus cleaned to some extent during rainy months. Cement dust and associated chemicals can spread over a large area through wind and rain, becoming accumulated in lichens, plants, animals and soils, and consequently, negatively affect in environment and human health.

### **Annual concentration of ambient air pollution:**

The average concentration of SPM in the ambient air of monitoring sites are above the standard values ( $200\mu\text{g}/\text{m}^3$ ) for residential and rural user. Table-2, denoted the higher concentration of SPM ( $314.04\mu\text{g}/\text{m}^3$ ) was recorded at Ariyalur Keelpaluvur region and lower concentration ( $261.66\mu\text{g}/\text{m}^3$ ) was recorded at Govindapuram. The highest concentration of SPM have been reported in various part of India. According to present study, the gaseous pollutants ( $\text{SO}_2$  and  $\text{NO}_x$ ) are well within standard value ( $80\mu\text{g}/\text{m}^3$ ) prescribed by CPCB, New Delhi for residential and rural uses. Out of five sampling sites the higher concentration of  $\text{SO}_2$  was recorded at Alathiyur ( $37.36\mu\text{g}/\text{m}^3$ ) followed by Keelpaluvur ( $37.07\mu\text{g}/\text{m}^3$ ), Govindapuram ( $33.67\mu\text{g}/\text{m}^3$ ), Thamaraiikulam ( $32.77\mu\text{g}/\text{m}^3$ ) and Thalavai. ( $29.50\mu\text{g}/\text{m}^3$ ). Whereas maximum  $\text{NO}_x$  concentration in the ambient air of Keelpaluvur ( $39.07\mu\text{g}/\text{m}^3$ ) to be followed by Thamaraiikulam ( $37.44\mu\text{g}/\text{m}^3$ ), Alathiyur ( $37.35\mu\text{g}/\text{m}^3$ ), Thalavai ( $34.83\mu\text{g}/\text{m}^3$ ) and Govindapuram ( $33.65\mu\text{g}/\text{m}^3$ ). In the present study, the gaseous pollutant  $\text{SO}_2$  and  $\text{NO}_x$  concentration in Ariyalur city are found to be decreasing order.

### **Air quality index (AQI):**

Air quality index (AQI) is developed to provide the information about air quality. Air quality index (AQI) was introduced by Environmental Protection Agency (EPA) in USA to measure the level of pollution due to major air pollutant. It is one of the important tools available for analyzing and representing air quality status uniformly. Table-3, indicate the concentrations of the major pollutants are monitored and subsequently converted into AQI. Whereas, table-4, using standard formula and rating scale was also calculated. Result indicate the higher Air Quality Index (32.81) at Keelpaluvur to be followed by Alathiyur (31.08), Thamaraiikulam (30.51), Thalavai (29.22) and Govindapuram (28.27) and rating scale as LAP “Light air pollution” during study period. The high  $\text{SO}_2$  concentrations of about  $20 - 40\mu\text{g}/\text{m}^3$  in most of the city in developing countries

and the daily average values rarely exceed  $125 \mu\text{g}/\text{m}^3$  and annual mean concentrations of  $\text{NO}_2$  recorded in most cities across the globe, not exceeding  $40 \mu\text{g}/\text{m}^3$ .

### Human health diseases:

As the most common route for pollutants to enter the human body is by inhalation, the most common effect of air pollution is damage to the respiratory system. Exposure to air pollutants can causing respiratory diseases (such as lung cancer, tuberculosis, asthma, bronchitis and emphysema), gastrointestinal diseases, blood pressure diseases, dental diseases, eye questionnaire based survey was conducted to get the statistics for incidence of various diseases among the people of sampling sites. Survey was conducted for general incidence of various diseases among the people of five sampling sites. figure-1, indicate that about 93.26 % male, 82.22 % female and 40.06 % children at Keelpaluvur, 75.13% male, 65.35% female and 35.27% children at Alathiyur ,87.38% male, 61.49% female and 38.11% children at Thamaraiikulam, 67.49% male,58.93% female and 41.50% Thalavai Whereas 51.40% male, 35.75% female and 39.11% children at Govindapuram were affected due to cement air pollution in Ariyalur city (figure-1).

**Table-5** Represent the percentage of person suffering from respiratory diseases was found in the range of 28.35 % to 52.54 % at all sampling sites, The estimated gastrointestinal percentage at five sampling sites varied between 20.07 % to 40.65%, blood pressure diseases was found in the range of 13.47% to 33.61% at the sampling sites, dental diseases varied between 15.99% to 28.00% at five sampling sites. All the sampling sites exhibited eye diseases in the range of 13.80% to 25.03%, out of five sampling sites skin diseases found in the range between 13.44% to 35.59% whereas other diseases found in the range of 9.76% to 23.10% at all sampling sites during survey period. Out of five sampling sites, showed maximum percentage of person suffering from respiratory disease which is higher at Thamaraiikulam (52.54%) to be followed by Govindapuram (46.90%), Keelpaluvur (46.32%), Alathiyur (42.27%) and Thalavai (28.35%).

Health effects of SPM in humans depends on particle size, concentrations and exposure time. Exposure to  $200 \mu\text{g}/\text{m}^3$  of particulate matter can cause upper respiratory diseases and  $294-470 \mu\text{g}/\text{m}^3$  depress immune function in children. Our results confirmed what has already been argued in the literature. The analysis certifies the harmful effects of air pollution and weather parameters mostly  $\text{SO}_2$  was positively correlated with health admission for every additional  $100 \mu\text{g}/\text{m}^3$  and  $25 \mu\text{g}/\text{m}^3$ , respectively. Significant also seemed to be the results for other pollutants, such as  $\text{NO}_2$  and  $\text{CO}$ . In other studies  $\text{NO}_2$  was positively associated with cardiovascular admissions and death increased risk ranging from 14% (admissions for every 10 PPhm) to 1% (death for every  $10 \mu\text{g}/\text{m}^3$ ). International studies have conformed association between elevated levels of particulate air pollution and increase in respiratory symptoms such as cough, shortness of breath, wheezing and asthma attacks. The resulting exposure to cement dust has led to impairment of respiration and a prevalence of respiratory symptoms amongst

workers culminating in what has been described as a “Cement factory lung disease”. The severity of the impairment of respiratory function has been shown to depend on years of exposure.

## Conclusion

The main environmental issue associated with cement production is the emission of pollutants (SPM, SO<sub>2</sub> and NO<sub>x</sub>) in the atmosphere. These air pollutants have long been associated with prevalence of various diseases in human beings. Results revealed higher concentrations of SPM in the ambient air of all the selected villages than permissible limit of 200µg/m<sup>3</sup>, prescribed by central Pollution Control Board, New Delhi. Contrarily, the ambient air SO<sub>2</sub> and NO<sub>x</sub> concentration have been estimated below the permissible limit of 80µg/m<sup>3</sup>, Prescribed by CPCB, New Delhi. Result indicated higher SPM, SO<sub>2</sub> and NO<sub>x</sub> concentrations in the ambient air during winter months to be followed by summer and monsoon months. The human populations of all selected sites were surveyed for prevalence of various diseases such respiratory diseases, gastrointestinal diseases, blood pressure, dental diseases, eye diseases, skin diseases and other diseases. Result indicated maximum people of all selected sites suffering with respiratory diseases than other problems.

**Table- 1**

### Seasonal variation of air pollutants in the ambient air of sampling sites

Sl. No. Sampling site	SPM(µg/m <sup>3</sup> )			SO <sub>2</sub> (µg/m <sup>3</sup> )			NO <sub>x</sub> (µg/m <sup>3</sup> )		
	S	W	R	S	W	R	S	W	R
1. Govindapuram	287.65	325.07	172.25	38.05	42.71	20.26	37.02	42.21	21.72
2. Thamaraiikulam	326.87	387.02	213.03	38.17	45.01	15.13	40.22	44.75	27.36
3. Keelpaluvur	342.25	287.20	212.69	38.14	44.30	28.78	42.75	48.72	25.75
4. Alathiyur	289.26	378.76	202.72	35.72	52.69	23.67	39.75	46.70	25.60
5. Thalavai.	281.07	322.29	184.06	28.21	34.36	25.92	35.27	41.20	28.02

**Table -2**

**Annual concentration of different air pollutants in the ambient air of sampling sites**

Sl. No.	Sampling sites	SPM( $\mu\text{g}/\text{m}^3$ )	SO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )	NOX( $\mu\text{g}/\text{m}^3$ )
1.	Govindapuram	261.66	33.67	33.65
2.	Thamaraikulam	308.97	32.77	37.44
3.	Keelpaluvur	314.05	37.07	39.07
4.	Alathiyur	290.25	37.36	37.35
5.	Thalavai.	262.47	29.50	34.83

**Table – 3**

**Air Quality index of Sampling sites**

Sl. No.	Sampling sites	AQI
1.	Govindapuram	28.27
2.	Thamaraikulam	30.51
3.	Keelpaluvur	32.81
4.	Alathiyur	31.38
5.	Thalavai.	29.22

**Table -4**

**Rating scale of AQI value**

Sl. No.	Index value	Remarks
1.	0-25	Clean air pollution (CAP)
2.	26-50	Light air pollution (LAP)
3.	51-75	Moderate air pollution (MAP)
4.	76-100	Heavy air pollution (HAP)
5.	Above 100	Severe air pollution (SAP)

**Table- 5**

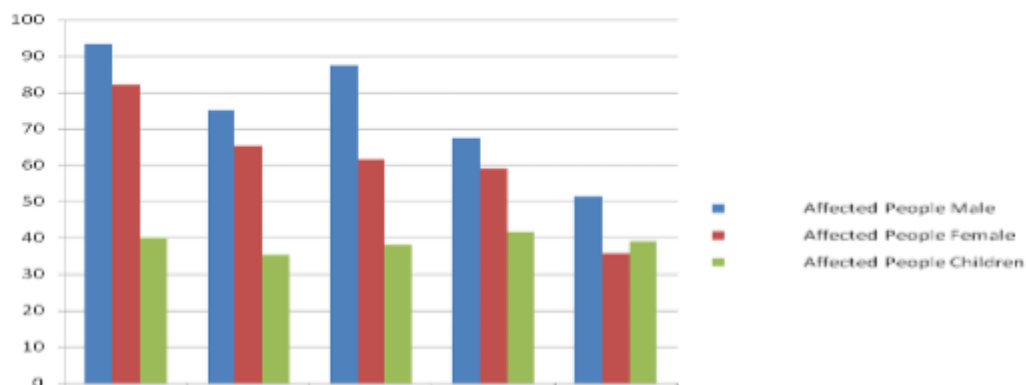
**Percentage of air pollution oriented diseases among the people of sampling sites.**

Sl. No.	Diseases	Sampling sites



		Govindapuram	Thamaraikulam	Keelpaluvur	Alathiyur	Thalavai.
1.	Respiratory diseases	46.90	52.54	46.32	42.27	28.35
2.	Gastrointestinal diseases	35.46	40.65	31.43	26.31	20.07
3.	Blood pressure	33.61	18.19	28.16	26.48	13.47
4.	Dental diseases	16.65	15.99	28.00	18.60	16.14
5.	Eye diseases	24.23	13.80	22.73	17.31	25.03
6.	Skin diseases	35.59	17.56	17.03	21.09	13.44
7.	Other diseases	23.10	17.02	13.24	15.86	9.76

Figure- 1 Occupational health diseases among the people due to air pollution



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