



Investigating the status of air pollution and comparing the concentration of its major pollutants in Shiraz, Iran

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Publication History

Received: 18 April 2017

Accepted: 09 June 2017

Published: July-September 2017

Citation

Ghasem Zolfaghari, Fatemeh Arab Amery, Mehri Delsouz. Investigating the status of air pollution and comparing the concentration of its major pollutants in Shiraz, Iran. *Climate Change*, 2017, 3(11), 810-815

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General Note



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ABSTRACT

Shiraz, as the eighth polluted metropolis in Iran, is facing the problem of air pollution due to the rapid development. The aim of this study was to evaluate the air pollution status in the city of Shiraz and the concentrations of pollutant gases of carbon dioxide, nitrogen oxides, particulate matter, hydrocarbons and sulfur oxides resulting from motor vehicles, industries and fuel consumption in various sectors. The polluting industries include cement plants, glass wool factory, Dena tire factory, domestic and commercial sources, oil refinery and the petrochemical industries. More than 75% of the air pollution results from fuel combustion in motor vehicles, 22% percent of which is related to the city's old vehicles. The air is more polluted than the allowed limit in terms of amount of carbon monoxide and particulate matter, which primary causes are the traffic and the movement of cars. About 85,000 liters of gasoline and 15,000 liter of diesel are used by the vehicles that produce about 32 tons of carbon monoxide, 3 tons of hydrocarbons and 0.8 tons of nitrogen oxides. The amounts of pollutants are more than the allowed limits in some days and the dust concentration is higher in the summer months. In this study, we provided some suggestions to reduce the air pollutants, including making gas-fueled automobiles, strengthening public transport system such as bus, subway and encouraging people to use public transport system, scrapping the old depreciate, development of examination system as well as determining the industrial areas so that their pollution would not be moved by the wind into the city.

Keywords

Motor vehicles, Industries, Domestic and commercial sources, Oil refinery, Petrochemical industries

1. INTRODUCTION

In general, the city of Shiraz has a warm and semi-arid climate. Shiraz is one of the most populous cities in Iran that due to being located between two mountain ranges at the southern end of the Zagros and the relatively high population growth as well as the increasing number and variety of pollutants, the problem of pollution seems to follow upward and non-avoidable trend over the time.¹ The pollutant parameters include carbon oxides, nitrogen oxides, sulfur oxides, soot, particulate matter and hydrocarbons. Recent surveys indicate that the mortality rate due to heart and lung diseases in cities occurring as the result of air pollution nowadays is 2.5 times of the rural areas. By disrupting the function of the mucosa of the ears, throat, larynx and other body secretory systems, the air pollution provides the grounds for infection and carcinogens. The latest conducted research indicates that breathing aerosols reduce the human life on average for one to two years, and developing cancer in various tissues, especially in the lungs, is as the harmful effects of air pollution, especially particulate matter. In a research performed in six hospitals in Tehran on heart patients in CCUs, it was found that there is a direct correlation between the number of heart patients and air pollution. According to the studies, the average hours of being outside home in men more are more than women's. Also, there is a direct relationship between the workplace and the residence location of patients and the percentage of people with heart diseases.² During the studies conducted on the relationship between air pollution and the population mortality in Tehran, the mortality rates due to cardiovascular diseases, respiratory diseases and strokes during the studied years were as 38.5%, 4.5% and 4.9%, respectively.³

2. RESEARCH BACKGROUND

In a study on the impact of air pollutants on the number of patients with cardiovascular- respiratory diseases referring to Shiraz hospitals, Dehghani et al. (2013) observed that PM₁₀ is the most important air pollutant factor, and the cardiovascular- respiratory patients referred to hospitals in Shiraz was related to CO. In a study entitled as "Traffic and environmental assessment of adding three special lines to the urban network of city of Shiraz, Mosalanejad and Hadigheh Javani (2013) came to the conclusion of these lines has been successful according to the results of the simulation software and based on traffic and environmental parameters with reducing the share of personal transport and greater use of public transport and has had a significant impact on reducing the emission of environmental pollutants and energy consumption and a noticeable increase of effective speed and delay reduction. In examining the effect of fuel quotas on the amount of air pollutants in the city of Shiraz, Rezaei and Rahmanikhah (2012) concluded that the implementation of fuel rationing plan is successful in reducing gasoline consumption, and thus, the reduction of air pollutants. In assessing the changes in air pollutants and the influence of meteorological parameters in the city of Shiraz, Nozhat et al. (2014) concluded that the amount of carbon monoxide in the fall, sulfur dioxide emissions in summer and dust in summer and winter have been the highest, and higher than the limit set in the urban areas. One of the main causes of this pollution is motor vehicles.

3. IDENTIFYING THE INDUSTRIES AND SOURCES OF AIR POLLUTION IN SHIRAZ

In recent years, the process of industries and sources of air pollution in the province of Fars have been visited, and in every step, a special questionnaire has been completed and the required data has been collected. The total units visited in Fars province accounted for 691 units, including asphalt factories, gypsum factories, lime furnaces, brick furnaces; casting plants, cement plants, etc.⁴

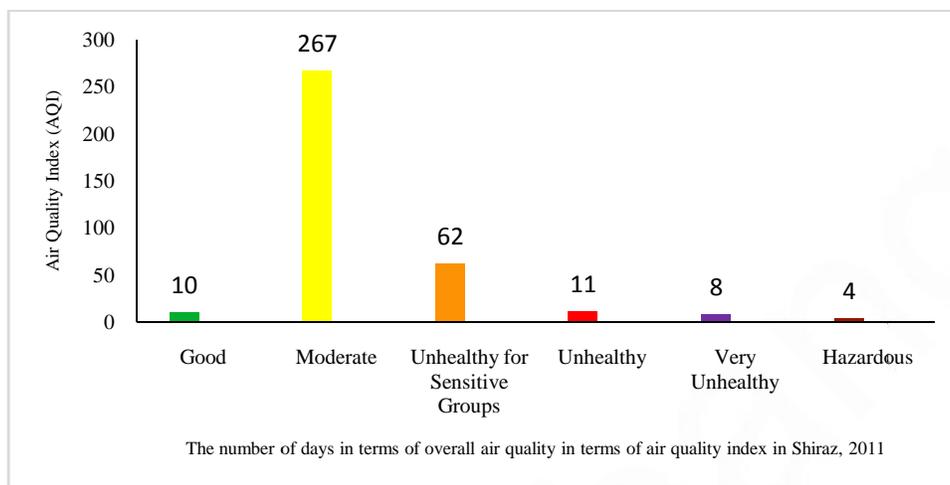


Chart 1 General status of air quality in terms of air quality index in Shiraz, 2011

According to a chart 1, the air quality of city of Shiraz was higher than the EPA standard for 85 days in Shiraz that the particulate matter (PM₁₀) emissions were recognized responsible on most days of the year. The average annual concentration of particulate matter was as 86 $\mu\text{g}/\text{m}^3$; this rate is 4.3 times of the national standard. The cumulative number of deaths attributable to this emission accounted for 362 cases. The air quality mean index in this year was 92.2. Also, March, April, July and October, respectively with the average indices of 138.25, 115.76, 106 and 104 (Air Quality Index) have been the most polluted months of the year (chart 1).

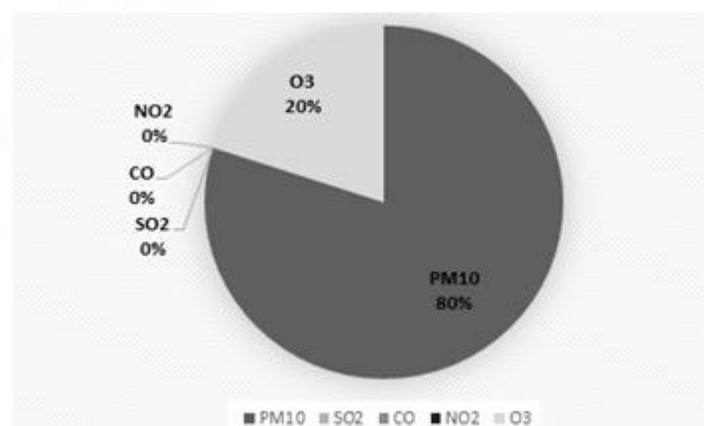


Chart 2 Contributing Contributors to Pollution in Shiraz, 2011

According to a chart 2, Particulate matter and ozone had the highest contribution in all seasons of the year in the exceeding of air quality from the standard level. In summer, ozone showed its highest rate with 29%, while particulate matter was responsible by its largest value in the fall as 93.3% (According to a chart 2).⁹

3.1. Pollution due to mobile sources (urban transport fleet)

Vehicles are known as the largest source of air pollution. The statistics obtained from Fars Province Police Office revealed that since its establishment, the agency has numbered 226,167 cars and 35,138 motorcycles in the province. The annual consumption of 750,000 cubic meters of gasoline and 1.267 million cubic meters of diesel at the provincial level by vehicles suggests the large amounts of produced pollutants. In the range of city of Shiraz, in a peak hour at morning in November, the studied vehicles have used approximately 85,000 liters of gasoline and 15,000 liters of diesel, through which, they have produced about 32 tons of carbon monoxide, 3 tons of hydrocarbons and 0.8 tons of nitrogen oxides.⁴ These data indicate that, despite the higher speed of personal cars, the volume of passengers transfer was unfortunately much less than the buses, while the distances (mileage) traveled were much more than buses. These factors suggest the higher amount of fuel consumption, more depreciation, less safety, more traffic, and higher environmental pollution in the use of private cars.¹⁰

The fuel consumption of most of domestic manufactured cars accounts for 583 liters per hour, i.e., three times of the global standard. This means that producing pollution in the air is 3 times more than all parts of the world. At now, the average daily gasoline consumption of every car in the country (Iran) is equal to 75.10. This amount is more than three times of the value in Britain and more than 4 times in France. Given that the number of passenger cars in the country at the beginning of 2002 has been over 3.8 million, in this year, we have been forced to import about 6 million liters of gasoline a day. According to the automobile production trend in the country, the number of cars is expected to be over 5.5 units by 2022. Thus, the total amount of gasoline deficit over the next 20 years will be 500 billion liters. This deficiency should be compensated by spending about 112\$ billion for gasoline imports.¹¹

3.2. Pollution from stationary sources (industries)

Air pollution caused by industrial activities includes pollution caused by mineral fuel and pollutions from various industrial processes. Major industries and sources of Shiraz in relation to air pollution include the following industries.¹

Fars Cement Plant

During surveys carried out on Fars Cement Company (FCC cement engineering service center) and according to the cement factory strategic studies, the followings should be taken into consideration:

- Low levels of electro-filters design and the gap between warranty numbers and Iran's current standards table and the possible future standards of the country
- Other burnout filters of the plan, such as bag and sand filters
- Problems arising from the operation of production lines, contributing in pollution through increased temperature, reduced relative humidity and rising gas concentrations
- Electrical or mechanical problems in technical facilities and pollution control devices
- Presence of other pollution-generating areas, such as clinker hall and several site of material disposal from different lines of the plant
- Absence of measurement devices such as flow rate meters and humidity gauges or dysfunction of existing devices leading to deficiencies in information necessary for the optimal use of the systems
- Utilization of the maximum capacity and even over the ability of the pollution control devices, in particular, electro-filters, which have made these devices sensitive to the changes in the working conditions and reduced their distinction levels.
- Existing filtration equipment and classification of pollution

Pollution control and dust removal of Fars Cement Plant are done by electrical filters, bag filters, cyclones and sand filters. However, the exhaust gases account for about 700000 cubic meters per hour that about half of them are dust-removed by 4 electrical filters and the rest by 20 bag filters and sand filters. To evaluate the effect of dust caused by the performance of this plant, some measurements have been made around the cement plant and its suburbs, indicating a higher concentration of dust around the cement plant compared to the remote locations. The weighted average rate of pollution in Fars Cement Factory in 1996 has been as $54 \mu\text{g}/\text{m}^3$.¹

Wool and glass factory

This factory, located in the south of Shiraz, produces glass wool insulations. The plant has three 50-tons furnaces and has contracts for the modernization of the furnace under way. The furnace chimney output directly enters the atmosphere, and the output white smoke is detectable from a few kilometers. The prevailing wind of Shiraz scatters the factory pollution directly on the southern parts

of Shiraz, and unofficial reports from Azadegan clinic, in Edalat Boulevard, suggest the high rates of pulmonary and respiratory diseases among the inhabitants of the region.⁴

Dena Tire Factory

This factory is located in the East of Shiraz, and the only statistics available from the plant include annual consumption of fossil fuel and its gas consumption. There is no data available on the particulate matter in the exhaust stack and in the environment around the factory. However, it is expected that the use of talcum powder in the process of rubber production enters a considerable amount of suspended particles into the environment. There is data available on the concentration of pollutant emissions in the output of this unit. Therefore, the pollution generated by this unit has been entirely calculated based on the results from used fuels.⁴

Residential and commercial sources

Natural gas consumption is the main cause of air pollution resulting from domestic and commercial uses.⁴

Shiraz Oil Refinery and its role in air pollution

Shiraz Oil Refinery is located at km 25 of Shiraz to Marvdasht main road. The refinery capacity is 40000 barrels per day. The fuel consumption rates in furnaces and other parts of the refinery are as much as 6357 tons per month. The products of these units such as petrol, diesel, Mazut, bitumen and heavy products of the distillation towers that produce pollutants such as sulfur and nitrogen compounds, are as the main factors of polluting the environment, and air in particular.

Shiraz Petrochemical Industries

The pollutions caused by different units of the complex include air pollution by ammonia plant, air pollution by the urea plant, air pollution by unit of nitric acid, air pollution by the ammonium nitrate unit, and the air pollution by the Chlor-alkali unit. The active petrochemical plants and the factories under construction of this industry severely threaten the environment.

Industrial poles of the region

Shiraz is known as the hub of the electronics industry. This title is given to this city according to the important and major electrical and electronic industries operating in Shiraz, including Shiraz Electronic Industries, Iran Electronic Components industry, Iran Telecommunication Industry, Iran Telecommunications Factories, Fars Regional Electricity Company, Shiraz Special Zone Electrical and Electronics, and Shiraz Gas Power Plant.⁸

4. SUGGESTIONS

- Making CNG vehicles
- Strengthening the public transport systems such as buses, subways and encouraging people to use public transport
- Scrapping depreciate cars
- Expansion of technical inspection system
- Establishment of adequate coverage in the asphalt streets and sidewalks
- Creating suitable green spaces
- With increasing appropriate productivity and adjustment of prices in relation to the use of communication means such as phone and post within the city, and thus, increasing the public services efficiency to the people, most of non-essential travels within the city will be reduced.
- Determining and locating the industrial areas should be in such a way that the pollutions caused by these industries would not be moved by the wind into the city (an example of this problem is the Cement Plant).
- The Department of Environment is recommended to establish mobile stations for air pollution measurements.
- The Department of Environment is recommended to develop and provide guidelines to prevent air pollution for manufacturing industries.
- Strict recommendations by the Department of Environment to urban and industrial centers on the use of natural gas as a source of energy instead of using compounds such as petroleum and diesel
- Strict recommendations by the Department of Environment to National Oil Company in conjunction with the completion, repair and modification of old refining centers in order to produce higher quality products
- Strict recommendations by the Department of Environment to industrial centers on the creation of necessary facilities for measuring the concentrations of pollutants in the working area of the plant workers

- Development of gas network in other urban centers in the province to reduce pollution resulting from using fuels such as gasoline and diesel with the help of National Gas Company

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