

AIR POLLUTION (CASE STUDY OF KABUL'S ATMOSPHERE POLLUTION)

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ABSTRACT

Air pollution is one of the major environmental issues. It causes severe health effects and problems such as cancer, cardiovascular diseases etc. Kabul city, Afghanistan's capital with 4,860,880 populations is one of the polluted cities of the world. In this article, we deal with the primary and secondary pollutants, acid rain, its effects and the factors which are mainly responsible for these pollutants. The main air pollutant of concern is suspended particles, smog and the gases creating acid rain. Kabul has hundreds of thousands of cars and generators and the Residents burn wood, tire, and coal, which releases dangerous gases to the atmosphere and lack of green space also takes part in polluting the atmosphere. If the weather gets polluted like this, the deaths rate which is because of the air pollution will increase rapidly.

Keywords: primary and secondary pollutants, smoke, fossil fuels, photochemical smog.

Introduction

The primary components of pure dry air are nitrogen N_2 (72%), oxygen O_2 (20.9%), argon (0.9%), and carbon dioxide CO_2 (0.035% or 350 ppm). Water vapor is present in amounts which typically range from 0.5 to 3% at ground level, depending on temperature and relative humidity.

Analysis of air samples reveals the presence of hundreds of other substances in trace amounts (Harrison, 1999:35). In urban environment, there are pollutant compounds emitted to the atmosphere directly and these are called primary pollutants. However, many compounds react in the atmosphere, the products of such reactions are called secondary pollutants.

Urban pollution is largely the product of combustion processes. In ancient times cities experienced pollution problems due to wood smoke. However, it was the



transition to fossil fuel burning that caused the rapid development of air pollution problems.

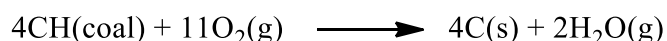
Fuels usually consist of hydrocarbons, and normal fuel combustion is an oxidation reaction and can be described:



This would not seem an especially dangerous activity as neither CO_2 nor water is particularly toxic. However, let us consider a situation where there is not enough O_2 during the combustion, i.e., as might occur inside an engine or boiler. The equation might now be written:



Here, we have produced carbon monoxide (CO), a poisonous gas. With even less oxygen we can get carbon (i.e., smoke).



At low temperatures, in situations where there is relatively little O_2 , pyrolysis reactions may cause a rearrangement of atoms that can lead to the formation of polycyclic aromatic hydrocarbons during combustion. The most notorious of these is benzo[a]pyrene; a cancer-inducing compound.

Besides CO_2 not being poisonous, CO_2 by dissolving in water makes it slightly acidic. However, some parts of the atmosphere, as shown below, are polluted with gases such as sulfur dioxide and nitrogen dioxide from combustion of impurities in fossil fuels. When these gases dissolve in rainwater, they make rain even more acidic, creating acid rain. When acid rain falls on statues made of limestone in the rock and erodes it. Limestone corrodes and stains when exposed to acid rain. Acid rain can be natural where volcanoes erupt or plants decompose, both release carbon dioxide gas, which makes rainwater acidic. But it is more potent when caused by human pollution activities. Industrial plants such as power stations pump large amounts of gases, such as sulfur dioxide, into the atmosphere. Acid rain reacts with metals, rock, and other materials. This damages and erodes buildings made of these material and acid rain is poisonous to plants. Acid rain damages leaves, reducing the rate of photosynthesis and reduces root growth, preventing the absorption of nutrients. It lots of acid rain falls in rivers or lakes, it raises the acidity of the

water. Most animals can't survive in acidic conditions (Saunders, 2020:256).

In addition to these, contaminants within the fuel can also cause air pollution. The most common and worrisome impurity in fossil fuels is Sulphur (S), partly present as the mineral pyrite, FeS. There may be as much as 6% Sulphur in some coals, and this is converted to SO₂ on combustion. SO₂, as mentioned above is one of the very serious air pollutants which makes the atmospheric water acidic and causes lots of damage to many things.

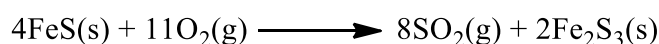


Table 1 Sulphur contents of fuels

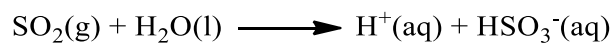
Fuel	S (% by weight)
Coal	7.0 – 0.2
Fuel oil	4.0 – 0.5
Coke	2.5 – 1.5
Diesel fuel	0.9 – 0.3
Petrol	0.1
Kerosene	0.1
Wood	Very small
Natural gas	Very small

There are other impurities in fuels too, but Sulphur has always been seen as most characteristic of the air pollution problems of cities.

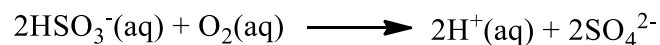
If we look at the composition of various fuels (Table 1), we see that they contain quite variable amounts of Sulphur. The highest amounts of Sulphur are found in coals and in fuel oils. These are the fuels used in stationary sources such as boilers, furnaces (and traditionally steam engines), domestic chimneys, steam turbines and power stations. Underdeveloped countries, Afghanistan which is one the underdeveloped countries, uses coals and fuel oils among others for the purpose of creating energy in various forms. Thus, the main source of Sulphur pollution, and indeed smoke, in the urban atmosphere is the stationary source. Smoke too is mainly associated with stationary source.

Classical air pollution incidents (usually) occur under damp and foggy conditions in winter. The presence of smoke and fog together led to the invention of the word smog (sm[oke and f]og), now often used to describe air pollution in general.

Sulphur dioxide is soluble so could dissolve into the water that condensed around smoke particles (Andreas et al., 2004: 46-48). Global dimming, a serious air pollution is one of the air pollution problems of Kabul city also. Tiny pollutant particles that are released into the Earth's atmosphere block the Sun's light. Over time, this has led to less light passing through the atmosphere, especially in cities and industrial areas, leading to global dimming (Saunders, 2020:255).



Traces of metal contaminants (iron (Fe) or manganese (Mg)) catalyzed the conversion of dissolve SO_2 to H_2SO_4 .



Sulphuric acid has a great affinity for water, so the droplet absorbed more water. Gradually the droplets grew, and the fog thickened, attaining very low pH values.

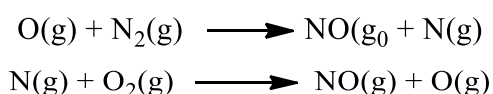
The transition to petroleum derived fuels this century has seen the emergence of an entirely new kind of air pollution. This newer form of pollution is the result of the greater volatility of liquid fuels. The motor vehicles are such an important consumer of liquid fuels that it has become a major source of contemporary air pollution. However, the pollutants responsible for causing the problems are not themselves emitted by motor vehicles. Rather, they form in the atmosphere. These secondary pollutants are formed from the reactions of primary pollutants, such as NO and unburnt fuel, which come directly from the automobiles (Andreas et al., 2004: 46-48).

Photochemical smog also called oxidizing smog, is a big problem in big cities like Los Angeles, California, and in many cities around the world (e.g., in Tokyo, Paris, and Mexico City) and now it has taken the Kabul city. Smog cause eye irritation and lung damage; they can also have severe agricultural effects.

To make Photochemical smog, we need four things: Warm air, moist hotter than 290 Kelvins (63°F), lots of intense sunlight (hv), a lot of hydrocarbons and NO_x which usually means lots of cars and stable air masses, a city surrounded by walls of mountains (Hites 2007: 88).

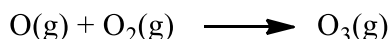
Kabul, the capital of Afghanistan is surrounded by mountains and has hundreds of thousands of cars which emits dangerous gases to the atmosphere. It has a moistened weather and lots of sunlight which the requirements of the air pollution.

The fact that we burn the fuels, not in O₂, but in air has important consequences. At the high temperatures, in a flame, molecules of air may fragment, and even the relatively inert nitrogen molecules can undergo reactions:

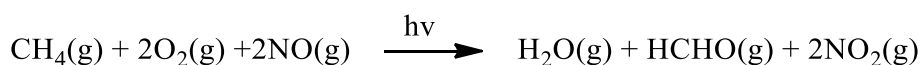


Once an oxygen atom is formed in a flame, it will be regenerated and contribute to a whole chain of reactions that produce NO. In addition, some fuels contain nitrogen compounds as impurities, so the combustion products of these impurities are a further source of nitrogen oxides (i.e., NO_x, the sum NO and NO₂).

This equation gives an isolated and reactive oxygen atom, which can react to form O₃:



Ozone is the single pollutant that most clearly characterizes photochemical smog, and it is a secondary pollutant. The volatile organic compounds released through the use of petroleum fuels serve to aid the conversion of NO to NO₂. The reactions are quite complicated, but the simplified one is:



We can see in the reaction that the automobile hydrocarbon is oxidized to an aldehyde (formaldehyde, HCHO). Aldehydes are eye irritants, at high concentrations, also carcinogens. This equation simply shows the net reactions in photochemical smog (Andreas et al. 2004: 50).

Pollutant particles in the air are toxic and can cause long-term health problems. They are dangerous because they are colorless, odorless, and typically can't be seen. They can impair our breathing and poison our blood. They may also darken buildings, block machinery, and some are flammable, presenting a fire risk. Hemoglobin is a protein in human blood that binds to oxygen which we

breathe in, carrying it around our bodies. Carbon monoxide molecules also bind to hemoglobin, preventing it from carrying enough oxygen and causing us to feel drowsy, become unconscious, or even die.

Results and discussion

Smoke smudges Kabul's sky Jan. 6. For Weeks, a toxic haze has blanked the city as cold as air traps pollution caused by people burning coal, wood, car tires, garbage and whatever they could find to stay warm (Horton 2019). The city covers an area size 1,023 square kilometers (395 sq. mi), which it is by far the largest city in the country, Afghanistan and it has 4,860,880 populations, 4,141,880 of the city's populations live in the city (Estimated Population of Afghanistan 2018-19) which are 669,602 families (Estimated Population of Afghanistan 2018-19).

Kabul's population has tripled over the past decade, and the capital buzzes with Soviet-era cars emitting thick plums of exhaust gases. Apartment buildings and the factories send columns and blankets of coal Smoke into the air, which grows even smoggier in winter as temperatures decreases and residents crank up their furnaces (Horton 2019).

It is estimated that, there are more than 5,000 vehicles in Kabul city, increasing year by year and is responsible for more than 36 per cent of Kabul city's air pollution (Shefayee 2019). There are millions of generators which are contributing to the air pollution of the city. Almost 40 per cent of the shops use generators for electricity purpose.

Ghulam Mohammad Malekyar, technical assistant to the Afghan Environmental Protection Agency says that 85 per cent of Kabul city's vehicles are over 15 years old and about 60 per cent of them have to leave the cycle. These cars are very old and need to be repaired in order to not participate in the air pollution of the city.

Lack of green space is another cause of Kabul city's pollution (Husaini 2019). Ahmad Oryakhel, a deputy head of the Kabul Municipality, says that there were only 7 to 8 thousand trees after the Taliban collapsed in Kabul, but now more than 300 million trees in Kabul have been planted for flooding and urban purification (Husaini 2019). However, these trees (in most cases) are covered with dust and dirt which prohibits the Sun's light from reaching the leaves and slows down its growth rate. Hundreds of these trees die because of dust covering their

leaves and prohibiting them to grow and eventually the trees die (Saunders, 2020:254).

Conclusion

Air pollution is one of the sever problems of the cities which are caused by man-made activities. Kabul, Afghanistan's capital, is one of the polluted cities of the world and the main source of pollution is caused by the actions and behaviors of the city's residents. Because of lack of electricity, hundreds of thousands of electricity generators are turned on daily in order to generate electricity. The residents also burn anything they can get to make their houses and places warm in the cold winters which make the atmosphere more and more polluted. The city's pollution can be decreased and reduced by the following cases:

1. Preventing from importing of the nonstandard fuels and prohibiting from the use of unauthorized fuels and brining of tires and coal. A lot of low quality and nonstandard fuels are imported to the country which causes asever and major problems of the air pollution and problems to the population of the country and especially in the city of Kabul, Afghanistan.

2. Most of the city's auxiliary roads are not asphalted and hence whenever the weather is rainy and snowy, cars and vehicles bring mud and clay to the main streets of the city; In this way the weather could become dusty. Dust and dirt are a major pollution problem in Kabul city and by asphaltting the streets, this problem could be solved.

3. By providing solar cells for electricity generating purpose which by reducing the use of generators, it helps in decreasing and reducing the pollution. The government could apply a limit in the use of generators for producing electricity and could encourage the population in order to use the solar energy and even offer some help and loans for them to use the solar energy instead of generators.

4. Planting the fields by plane-trees which grow faster than the cypress tress helps in controlling the air pollution. Trees absorbs the huge amounts of dust and dirt and through this dust and particulates which are one of the major contributors of the pollutants of the city gets cleaned and therefore, several problems are eliminated or at least reduced.

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