

The Impacts of Combustion Reaction on the Environment

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Abstract. Combustion reaction has been widely used in many aspects that kept modern life developing at such a desirable pace. In all combustion applications, the burning of fossil fuels has the most prominent world-wide implication in today's economic size and strength. This article provides information about fuel combustion, its development and applications in modern society, and its impacts on the environment. The essay also points out that as the most commonly-applied combustion, fossil fuel burning has been one of the culprits of many environmental problems, such as climate change and pollution. Under these conditions, some instant actions should be taken to relieve or even stop the negative impacts of fossil fuel combustion. In addition to official policies, environmental problems should also be solved and addressed with technological innovations in saving energy, which can truly help and facilitate a long-term sustainable development. Oxy-fuel is one of the advanced technologies for clean and highly efficient utilization of fossil fuels that can be used to release the adverse influence of fossil fuel combustion.

Keywords: Environment, combustion reaction, fossil fuels, forest fire, burning trash.

1. Introduction

Combustion reaction is generally referred to a chemical process of burning fuels. In this process of chemical reaction, a certain substance(fuel) can react rapidly with oxygen (oxidizer) and the heat energy is released as well as other kinds of by products, such as CO₂ emissions [1]. It has been long known that combustion was the first kind of under-controlled chemical reaction in human history, such as campfires and bonfires. In fact, since the first coal-fired steam engines invented in the 1800s, the burning of fossil fuels has become the most primary source of energy to activate and sustain human's development. For example, their combustion has been used to generate electricity, which could power transportation and industrial processes in today's world. But it cannot be ignored that these chemical reactions have emitted a large amount of unexpected and harmful pollutants, which has caused a lot of environmental degradation, such as global warming. This report aims to analyze the applications of fossil fuel burning, assess its impacts on natural environment, and further propose feasible strategies to optimize its applications and minimize its drawbacks.

2. The Applications of Fossil Fuel Combustion

A common phenomenon in today's world is that from home appliances that maintained basic family life to office machines that kept normal working order, every aspect of daily lives has relied heavily on the combustion of fossil fuels which have been the largest source of energy in human society even in today's world. As a matter of fact, since the First Industrial Revolution in 18th century, the burning of these traditional fuels has involved with a wide range of phenomena with diverse applications in fields of industry, professions, and households. Their burning has also facilitated many scientific achievements in different fields, such as physics, mechanics, and chemistry. All of these have together created human a series of unprecedented economic prosperity and technological advancements. But, the energy from fossil fuel combustion is not only what drives life, but also human greed.

3. The Types of Combustion Reaction

A detailed interpretation about the types of fossil fuels applications in today's world should be made, before entering the benefits and drawbacks of their burning. Fossil fuels are mainly comprised of coal, oil, and natural gas, which can release a tremendous amount of energy as well a huge number of harmful substances when burnt. In modern world, the phenomena of their combustion can be divided into five types [2]. The heating device is the first biggest type, which relies on the burning of gases, wood, coal, and liquid fuels, and currently is widely applied in vapour production and metallurgy. The second type can be termed as the combustion of explosives, which work with mechanical action or explosion, such as electric generators. What is more, the burning of fossil fuel is also applied in internal-combustion engines, such as gas turbines, turbojets, and ramjets. What should be also noting is that their combustion has played a critical role in rocket propulsion which has advanced the latest aircraft and spacecraft. At last, their burning reaction can be also presented in a series of theoretical and experimental researches.

The second widely-used chemical reaction in human society is to burn trash and rubbish. Burning trash and rubbish can reduce and prevent the production of methane, one of the most potent greenhouse gases, which is at least 84 times more potent than CO₂. According to the United Nation, burning the wastes in the landfill is very eco-friendly, based on the fact that this kind of combustion can reduce the amount greenhouse gases, and thus can release the severity of global warming to some degree [3]. What is more, burning these wastes can be also used to heat and energy. In fact, many countries, such as Sweden and UK, have already adopted this measure to produce electricity. The third commonly-seen combustion is forest fire. According to British Columbia, 60% wildfires in each season is cause by natural events like lightning and climate change. The other 40 % is a result of human activities like fire work, cigarette, and industrial [4]. What should be noting is that wildfires and climate change have a mutual exacerbate relationship. Wildfire is increasing the severity of climate change by inducing droughts, high temperature, and low humidity.

4. Negative Effects of Combustion on Environment

Of the three fossil fuels, such as coal, oil, and gas, the burning of the two formers have together released numerous potentially harmful substances into the atmosphere. One of the lethal substances is carbon dioxide emissions, which has been largely produced by automotive engines and for industrial and heating purposes in power plants. Therefore, it has become a consensus that the burning of coal, oil, and gas has already interrupted an ecological balance and posed many risks to human beings.

4.1. Climate Change

Few people would dispute that fossil fuel burning is the leading cause of today's catastrophic climate change. When the fossil fuels are burnt, they would release a large amount of greenhouse gases in to the air, such as carbon dioxide. Currently, over half of these warming gases is not absorbed and remains in the atmosphere, and has ultimately led global warming [5]. The world now is getting warm faster than at any point on the page of human history. Since the 18th century, the combustion of fossil fuels has accounted for nearly 90% carbon dioxide emissions, representing over 75% global greenhouse gas emissions [6]. According to a reliable report from Intergovernmental Panel on Climate Change, 89% global CO₂ emissions were derived from the fossil fuel combustion in 2018, and it can be expected that there is going to have 1.5 degree rise in temperature, which will exacerbate the frequency and intensity of some extreme weather and climate events [7].

4.2. Pollution and Loss of Biodiversity

There are also other large number of pollutants emitted in the combustion of fossil fuels, such as fly ash, sulfur oxides, and nitrogen oxides. New research from Harvard University, Birmingham, and University College London, has found that because of fossil fuel pollution, nearly 8 million people

died in 2018, which means that air pollution, caused by fossil fuel burning, can be attributed to the 20% deaths worldwide in this year [8]. Moreover, these inorganic pollutants have deteriorated a lot of natural habitats, and further threatened the biodiversity and ecosystems. According to WWF, there has been 69% decline in species since 1970, due to the increasing burning of fossil fuels [9]. The extraction and burning of fossil fuels, indirectly through climate change, have also disrupted the ocean ecosystems. For example, the ocean, during the century, has absorbed nearly 30% CO₂ emissions released from fossil fuel combustion, which has also altered the ocean's chemical properties, making it more acidic and harming a lot of marine life [10].

5. Positive Effects of Combustion on Environment

It is true that the burning of fossil fuels has caused both human and environment a lot of damages, but there are still other two forms of combustion, forest fire and waste burning, which are advantageous to the human life and natural environment.

5.1. Forest Fires

A forest fire can improve the natural cycle of forests' growth and their replenishment. First of all, the evolution of many plants and animals in a forest relies heavily on a regular or irregular wildfire, and this kind of burning indeed has been used by farmers around the world for centuries [11]. What is more, a forest fire can also help clear up some harmful organic materials, and thus animals and plants in the given niche can increase their likelihoods of survival and reproduction. When a dead tree grows up from the ground, it will prevent some harmful organisms in the soil from processing nutrients, or stop the plants or animals on the land from processing the soil. In this case, a wildfire can eliminate the layer of decay, and further increase soil fertility [12]. So, it is apparent that regular forest fires can bring our natural ecosystem a lot of benefits.

5.2. Trash and Garbage Burning

Burning trash and garbage can also create environment and human a lot of advantages. One of the obvious benefits is that such kind of combustion can offer a significant weapon against climate change, due to the fact that burning these wastes for the purpose of heat and electricity can make a considerable offset of CO₂ emissions from the fossils-fired power stations [3]. Secondly, this burning can recover metals for recycling and thus offset the emissions from mining. Thirdly, it can also release and even stop the harmful environmental effects of fossil fuels, such as drilling for oil and mining coal [13]. Moreover, the burning of these wastes can also help eliminate pathogens, such as a virus, bacterium, prion, fungus, or parasite that causes disease in humans. Last but not least, it can also reduce the volume of wastes by 90%, significantly conserving landfill capacity [14].

6. Suggestions

It is a well-established fact that the burning of fossil fuels has generated enormous toxic emissions, which not only led to serious climate change, such as global warming, but also severe environmental contamination, such as pollution. The environmental imbalance has damaged and degraded the survival condition for all life on Earth. Therefore, it is urgent to take decisive action to decrease the negative impacts caused by fossil fuel combustion.

6.1. Environmental Policies

Different countries or regions have already enforced their environmental policies conforming to their varied conditions. All of these policies are in general based on the principle of sustainable development (UN). Governments can propose a Command-and-Control approach, which means that all the organizations in the given territory are required to install specific pollution control devices and impose quantitative limits. If a company does not meet the standard, the company owner may face

the risks of closure of the business and even being in jail. In addition, governments can legitimate tax policies and subsidies measures, which can encourage a huge reduction in combustion reaction use. In fact, these tax policies can also be used as an incentive for technological invention, and thus governments can improve the efficiency of combustion and reduce its negatives as much as possible. Most importantly, an international environmental standard should be set up by a global cooperation from all countries and regions.

6.2. Technological Innovations

To minimize these negative impacts, many technological tools have been invented and implemented by human. They can strive to consume energy provided by fossil fuels as as little as possible. Oxy-fuel combustion was one of the technological achievements which is used in energy saving and environmental protection. It is a promising method to achieve high-efficiency clean combustion. As one of the most efficient carbon capture electricity generation technologies, it has greatly impressed the public in the past two decades. Its wide applications have not only saved a huge amount of heat energy, but also achieved a huge reduction in the CO₂ emission released from the burning of fossil fuel. Specifically, Oxy-fuel combustion uses pure oxygen, instead of air, as the most important oxidant in its combustion reaction. In the process, fire temperatures can be kept higher as much as possible because the nitrogen which is one of component in the air is not heated and the consumption of fossil fuels can be reduced [15]. Furthermore, it can also produce pure CO₂ which can be reused in power plants, instead of releasing into the atmosphere as a kind of typical pollutant [16]. Therefore, it has been used as one of the most promising technologies for reducing the need of fossil fuel and capturing the amount of CO₂ from the chemical combustion.

7. Conclusion

From what has been stated above, there is no question that combustion reaction has had a profound impact in human's development and environmental change. As the most widely-used combustion, fossil fuel burning has brought a lot of influence both environment and human society. However, it is also essential to consider that forest fires and trash burning have also been beneficial to the natural environment and human life to some extent. For its drawbacks, governments should continue to enact some reasonable and effective environmental policies and more technological products should focus on the energy-saving and environmental protection. To the end of the day, all countries or regions across the global should take their responsibilities to prevent or solve the environmental problems caused by the combustion reaction of fossil fuels.

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