Removal of CFC and HCL using CNS precipitator

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ABSTRACT

This paper discussed about the removal of Chlorofluorocarbon and Hydrochloric acid using CNS Precipitator. The electrode plates are placed in flow of exhaust air and grid is placed perpendicular to the chimney or parallel to the electrode plates. The power of 15V battery is given to the electrode plates through duct. The negative potential of the battery given to the duct and positive potential is grounded through chimney. The reduction process takes place in the duct. When ammonia is stored in cylinder and passes into duct at high pressure which is convert the harmful into harmless gas. This paper discussed about theoretically.

Keywords: Environmental pollution, CNS Precipitator, oxygen, harmful gas molecules, Electrostatic force of attraction and repulsion, CFC, HCl.

1. Introduction

The natural environment encompasses all living and non-living things occurring naturally on Earth or some region thereof. The natural environment is influenced by the built environment, which comprises the areas and components that are strongly influenced by humans. Universal natural resources and physical phenomena lacks clear-cut boundaries, such as air, water, and climate, as well as energy, radiation, electric charge, and magnetism which are not originating from human activity. But these natural resources are being misused by human beings and one of the major problems that the environment is facing is pollution. There are different kinds of pollutions and one among them is the air pollution which is the significant one and it causes many demerits to the whole human race and also to the mother earth. Indoor air pollution and urban air quality are listed as two of the world’s worst pollution problems (Blacksmith Institute World's Worst Polluted Places report, 2008). Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere. The atmosphere is a complex dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems. Hence, the present study was taken up to tackle this pollution.

2. Literature review

The first use of corona discharge to remove particles from an aerosol was done as early as in 1824. An electrostatic precipitator (ESP) or electrostatic air cleaner is a particulate collection
device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulate matter such as dust and smoke from the air stream. In contrast to wet scrubbers which apply energy directly to the flowing fluid medium, an ESP applies energy only to the particulate matter being collected and therefore is very efficient in its consumption of energy (in the form of electricity of direct current about 35KV). Earlier the electrostatic precipitator using a voltage of 10.5 kilovolt has been patented by Furuta 2005.

3. Experimental setup

3.1 CNS precipitator

CNS is used to remove the Harmful gas molecules from exhaust gases from various man made sources. In this method, the reduction process is more efficient and electrostatic force of attraction and repulsion. The gases like carbon monoxide, carbon dioxide, hydrocarbons, oxides of sulphur, oxides of nitrogen etc are present in these gases. The present study was taken up for the separation of positive and negative ions in the gas molecules like carbon monoxide, carbon dioxide, hydrocarbons, oxides of sulphur, oxides of nitrogen.

3.2 Principle of process

This process works on the principle of: “theory of electrolytic conductance”. Arrhenius Theory says “In water solution, the neutral electrolytic molecule is split up into two types of charged particles. These particles are called as ions and the process is known as ionization”. This theory concept is used in gas molecule not only weak electrolytic and used also strong electrolyte.

\[ A \ B \rightarrow A^+ + B^- \]

Example data:
1. In water solution, NaCl exists as Na\(^+\) Cl\(^-\);
2. In air, CO gas exists as C\(^+\) O\(^-\).

3.3 Construction of process

For removal of CFC and HCl, The main parts of GMP are follows:
1. Chimney,
2. Duct,
3. Electrode plates,
4. Grid or nozzle and
5. Voltage source (Battery 15Volt).

The chimney is fitted with the CFC or HCl exhaust equipment. The duct is T-shaped tube consists of slot 1, slot 2 and slot 3. The slot 1 consists of electrode plates which are placed in horizontal axis (X axis) and slot faced left hand side. The slot 2 consists of grid with nozzle or direct nozzle which is placed in vertical axis (Y axis) and slot faced upward. The slot 3 consists of harmless solid precipitator and link between slot 3 and cylinder through pipe which is placed in vertical axis (Y axis) and slot faced downward. The battery of 15V is
connected to the T-shaped tube or pipe (negative terminal) and duct (positive terminal) which is act as ground.

**Figure 1:** Experimental setup for removal of CFC and HCl

### 3.4 Working of process

For working of experimental setup of removal of CFC and HCl, The charge of battery given to the T-shaped tube and duct leads to reduction process takes place in the exhaust gas having CO, CO₂, CₓHᵧ, SOₓ, NOₓ, HCl, CF₂Cl₂ etc., This reduction process leads to convert the harmful gas into harmless gas. The CFC reduce to form chlorine and fluorine gas and carbon precipitate in the dust precipitator. The HCl is reduced to form hydrogen and chlorine gas. The chlorine and fluorine gas are poisonous. So, the ammonia gas comes out from grid or nozzle from cylinder through pump, control valve and pressure regulator.

### 3.5 Reduction process involve in the GMP

The reduction process takes place inside duct (Electrode plates) for all molecules. Some of important harmful gas molecules followed in below table.

**Table 1:** Reduction Process Involve in gas molecules

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Reduction process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide</td>
<td>2CO → 2C + O₂</td>
</tr>
<tr>
<td>CFC</td>
<td>CF₂Cl₂ → C + F₂ + Cl₂</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>2HCl → H₂ + Cl₂</td>
</tr>
</tbody>
</table>

Note: F₂ and Cl₂ are poison
3.6 Removal of poisonous gas

When reduction process takes place in molecule of CFC and HCl. The exhaust gas is Chlorine and Fluorine is Poisonous. So, Ammonia gas is added to change into harmless gas. The following reaction with ammonia is followed below Table.

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Parameter</th>
<th>Reaction with NH₃</th>
<th>Properties and applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ammonia gas in excess</td>
<td>8NH₃ + 3Cl₂ $\rightarrow$ 6NH₄Cl + N₂ 8NH₃ + 3F₂ $\rightarrow$ 6NH₄F + N₂</td>
<td>It is non-poisonous and used for fertilizer</td>
</tr>
<tr>
<td>2</td>
<td>Ammonia gas in normal</td>
<td>2NH₃ + 3Cl₂ $\rightarrow$ 6HCl + N₂ 2NH₃ + 3F₂ $\rightarrow$ 6HF + N₂</td>
<td>It is non-poisonous and high corrosive</td>
</tr>
<tr>
<td>3</td>
<td>Chlorine gas in excess</td>
<td>NH₃ + 3Cl₂ $\rightarrow$ NCl₃ + 3HCl NH₃ + 3F₂ $\rightarrow$ NF₃ + 3HCl</td>
<td>NCl₃ and NF₃ are explosives</td>
</tr>
</tbody>
</table>

Note: we compare properties and application ammonia gas in excess passed into the grid.

3.7 Selection of voltage for electrode

The maximum or minimum voltage accepts by the substance, without any disturbance occurs in the substance that is called as standard potential. The standard potential means the potential of a redox reaction, when it is at equilibrium, in relation to zero. When the standard potential exceeds zero, we are dealing with an oxidation reaction. When the standard potential is below zero, we are dealing with a reduction reaction. The standard potential of electrons is expressed in volt (V), by the symbol V⁰.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Standard voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>11.26v</td>
</tr>
<tr>
<td>Sulphur</td>
<td>10.36v</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>14.53v</td>
</tr>
</tbody>
</table>

The voltage given to the electrode should be greater than standard voltage of C, N and S. So, the 15v is given.

4. Testing of GMP process

4.1 Chemical test

Carbon dioxide & carbon monoxide

The dissolved calcium hydroxide is taken in a beaker. The exhaust gas from the duct was allowed to pass through it. The formation of white turbidity indicates the presence of Carbon dioxide & carbon monoxide.

4.2. Actual reading test

When there is tested in computerized testing machine to calculate the exhaust harmful gas molecules content. The various testing of GMP is followed below the table.
5. Result and discussion

5.1 Theoretical prove of CFC and HCl

The GMP is used to break the bond of carbon monoxide. The carbon monoxide (C≡O) has triple bond. The covalent bond present in the molecule is the strongest one. But, CFC having single bond (F₂-C-Cl₂), it is weaker than triple bond. So, the GMP definitely breaks the single bond. The testing of carbon monoxide is shown in Actual reading test. The removal of CO is proved by testing.

5.2 Advantages of CNS process

5.2.1 Basic advantages

1. It’s very cheapest method,
2. Maintenance and Running cost are low,
3. Ammonia gas is easy available.

5.2.2 Advantages to human

1. Asthma disease is reduced. due to, increases the liberation of O₂ content,
2. Respiratory problem, lung and throat irritation is reduced,
3. Death of human depends on pollution is reduced.

5.2.3 Advantages to environment

1. Reduction of global warming. Due to, increases the liberation of O₂ content, reduces the librations of CO, CO₂, Hydrocarbons,
2. Climatic changes are changes into normal and Global temperature is reduced. Due to, Reduction of global warming,
3. Ozone hole is closed. Due to, dead of pollutant molecules in atmosphere,
4. Glaciers should not change into liquid. Due to, Ozone hole is closed.

6. Conclusion

The paper has emitted various precautionary measures in pollution control. Climatic change will be normal. Humans, plants & animals are not affected by air pollution. The temperature increases in globe will be reduced. We conclude that this very useful to reduce the chlorofluorocarbon and hydrochloric acid by proved in theoretically. This process is very useful to create the better environment.
7. References


