

Absorption of Carbon Dioxide from Vehicle Using Lithium Hydroxide

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Abstract- A method system and apparatus for removal of carbon dioxide from vehicle in order to control vehicular pollution is disclosed. Lithium hydroxide is fixed in exhaust gas outlet of vehicle such that it absorbs carbon dioxide and form lithium carbonate. From lithium carbonate with the initiation of transition metal and solar energy we can produce carbon nano-fibers and oxygen. With the process the carbon dioxide emission is reduced and oxygen can be produced such that it will act as a weapon for climatic change. The vehicle at high speed releases the exhaust gas and reacting, such air with lithium hydroxide stops carbon dioxide emission and lithium carbonate is available as product which can be used widely.

Keywords: carbon dioxide, lithium hydroxide, lithium carbonate, Exhaust Gas Circulation

I. INTRODUCTION

The increase in level of carbon dioxide will have same global consequences in future. There are two ways in which carbon dioxide level in atmosphere is increased via industries and automobiles(1). Due to these emissions there will be chances of ozone depletion, ecological imbalance, spread of disease and so on. It is said that the level of carbon dioxide is increased by 1 or 2 ppm every year. Due to these increases in level of carbon dioxide marines lives affect a lot. The ocean absorbs 22 million tons of carbon dioxide every day which leads to imbalance in marine diversity, due to the excess of carbon dioxide in ocean results in production of carbonic acid (H_2CO_3) which increase acidity of sea water.

Therefore the reduction of carbon dioxide has become an important and essential concern now-a-days. The reducing of carbon dioxide emission has been a significant focus on research for some time.

The capture of carbon dioxide by any chemical operation is continued research now-a-days the sources of carbon dioxide are mainly from industries and automobiles. The capture of carbon dioxide from these two areas is most essential one.

In industries, there is lot of operations involved to prevent carbon dioxide emission in atmosphere air. Adsorbents like activated carbons is used in exhaust gas outlet to control carbon dioxide emission in atmosphere(1). But in case of automobiles, no such steps are taken and now as population has increased, the percentage of carbon dioxide in atmosphere also increases.

It is known that hydroxide reacts with carbon dioxide to form carbonate. Therefore lithium hydroxide is placed on the exhaust gas chamber of each vehicle such that the carbon dioxide gets absorbed by lithium hydroxide to form lithium carbonate (2).

The temperature of exhaust gas will be high and at required temperature (90-120 celcius), the carbon dioxide will be absorbed by lithium hydroxide and lithium carbonate is formed. There is no need of external heating is needed to it.

The space shuttle uses this absorption method to remove carbon dioxide using sorbent lithium dioxide. This reaction is exothermic such that lithium carbonate and water are formed as products.

The lithium carbonate formed can be used for many purposes. Carbon nano-fibers can be produced using lithium carbonate with the help of solar energy and transition metals as initiator.

II. MATERIALS AND METHODS

Hydroxides are generally preferred to convert carbon dioxide in their respective carbonates. Lithium hydroxide can be preferred among other hydroxides because of its high absorption capacity of carbon dioxide and the small amount of heat produced in the reaction. Lithium hydroxide solution is a clear water-white liquid contains pungent odor. It may cause severe irritation to skin, eyes and mucous membrane it may be toxic by ingestion inhabitation, skin absorption. Even though it has toxic contents, it is less toxic among other hydroxides.

At first consistent of appropriate sizes based on the type of vehicle is fixed to the exhaust gas outlet (silencer). Then the canisters are filled with lithium hydroxide. The concentration of lithium hydroxide should be 60 to 80 g/L such that it absorbs carbon dioxide easily.

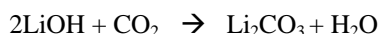
When the vehicle is in operation, combustion takes places such that exhaust gas comes out through silencer. As canister filled with lithium hydroxide are fixed in silencers, at optimum temperature (90-120 celcius) the lithium hydroxide absorbs carbon dioxide and forms lithium carbonate. As the temperature keeps on increasing during vehicle operation, lithium hydroxide gets converted to lithium carbonate. Even if temperature increase beyond optimum temperature, due to lithium hydroxide and lithium carbonate's high melting point no decomposition takes place. The reaction gets stopped when the temperature of exhaust gas is much more than optimum temperature.

The maximum temperature of exhaust gas from vehicles will be around 650 celcius. Therefore in order to proceeds the reaction, cooler should be fixed along with the canister. For efficient absorption of carbon dioxide, multiple canisters ought to be fixed in exhaust gas outlet of varying

size. The canister which is fixed in left should be of greater size and it should decrease towards its right.

III. PROCESS ASSUMPTION

The reactions of process is as follows,



Molecular weight of lithium hydroxide: 20

Molecular weight of carbon dioxide: 44

From the above reaction it is known that for absorbing 44gm of CO_2 , 40 gm of LiOH required. A vehicle emits 120gm of CO_2 in 1 km distance.

Density of LiOH is 1.43gm/mol, therefore 1litre of LiOH contains 1430gm.

1430gm of LiOH absorbs 1530gm of CO_2 .

A vehicle requires 13 km to produce 1530gm of CO_2 .

So 1 L of LiOH in vehicle absorbs CO_2 up to 13 km.

The coolant should be fixed based on the type of vehicle and in order to increase efficient absorption, multiple coolants have to be used. Temperature controlling of exhaust gas is a challenge in this process. Even instead of fixing coolants, exhaust gas recirculation (ERG) can also be used. ERG is a nitrogen oxide reduction technique which results in decrease in exhaust gas temperature. Based on the temperature of exhaust gas, we can use ERG and coolants. To reduce temperature drastically, multiple coolants are used along with the multiple canisters which are fixed in the exhaust gas outlet. The advantage is that the reaction proceeds at optimum temperature and the product formed will not decompose at high temperature. Therefore based on vehicle operation and activity, efficiency of absorption is determined. For low operation and running activity of vehicles, ERG technique suitable as it reduces exhaust gas temperature and nitrogen oxide emission and thereby increases the rate of absorption of carbon dioxide. For high operation and running activity, coolers and multiple canisters ought to be used. The canisters are arranged in such a way that their sizes should be in increasing order from the first outlet to the end of the silencer.

Initially when the vehicle starts operating, temperature of exhaust gas increases gradually. When it reaches optimum temperature it goes to first canister where absorption of carbon dioxide takes place. Then the temperature gets increased beyond the optimum temperature at that time there is no use for first canister. The exhaust gas moves to second canisters. While moving, coolers are kept, therefore from first and second canister, temperature decreases gradually. Absorption takes place at second canister the size of second canisters should be large compared to the first canisters. As these steps continue for multiple canister placements, absorption of carbon dioxide will be more effective. The canisters can be fixed in a slightly or in a sloppy manner such that there will be effective contact between the carbon dioxide and lithium hydroxide.

The number of canisters was decided according to our requirements, cost and activity of the vehicle. As lithium hydroxide is slightly corrosive based on activity of vehicle,

the canisters ought to be fixed and it should be replaced frequently.

The obtained product lithium carbonate has many uses commercially. It is used to treat bipolar disorder. It is used in medical fields. It is used as a reducing agent in ceramic industries.

It is used for quick setting of cements. Apart from these uses, by electro chemical method, carbon nano fibers are produced (by litch process). The carbon dioxide which is present in molten carbonate can be electrolyzed to form carbon nano-fibers and oxygen.

3.1 Advantage of choosing lithium hydroxide over other hydroxides

1. It is less toxic compared to other hydroxides.
2. The fixed product lithium carbonate can be used for treatment of bipolar disorder
3. The final product lithium carbonate is eco friendly
4. The product obtained lithium carbonate can be used to produce carbon nano fibers and oxygen (by lithium process)

IV. SUMMARY AND DISCUSSION

1. This is the method of capturing of carbon dioxide by lithium hydroxide in vehicles is efficient method compared to other methods.
2. Hydroxide of lithium is chosen as it has many advantages than other metal hydroxides.
3. Hydroxides of other metal form carbonate sol which are not eco friendly in nature
4. The major advantage of technique is reaction proceeds in optimum temperature and we can improve its efficiency according to our need.
5. This technique is best suitable for low activity vehicles as this technique stops nitrogen oxides and carbon dioxide emission to the atmosphere.
6. Temperature controlling of exhaust gas is on challenge in this absorbing technique but still usage of coolant can improve efficiency of absorption to greater extent.
7. Due to irreversible nature, it should be replaced for time based on activity of vehicle. This absorption technique provide way to many production such as carbon nano fibers and oxygen.
8. It is an eco friendly process and its final product is used in cement, ceramics and for medical process.

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