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EMPHATIC REPERCUSSION OF CO_2 IN PRECIPITATION OF MONSOON CLOUDS

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ABSTRACT-

Carbon oxide gas has versatile applications and significance role in the field of physical world of Chemistry, Biology and Environmental science and more serious hazardous role if its presence is disbalanced by anthropogenic activities over the globe. Despite of adverse effect on our environment we can maneuver promising application of carbon dioxide gas in enhancing the artificial rain by inducing precipitation of low altitude cloud in monsoon season. With help of drone, carbon dioxide can be lifted and spayed in lower clouds for required precipitation as our laboratory experimental data evidently revealed appreciable precipitation enhancement by admixing carbon dioxide gas in saturated vapour under controlled conditions. In present paper we focus on how carbon dioxide technically reacts with water molecules and helps in nucleation around it through condensing vapour in the form of droplets. The details have been discussed further with the rigorous data analysis.

Key words: Carbon dioxide, condensation of vapour by carbon dioxide, nucleation of droplets precipitation of clouds.

INTRODUCTION-

Globally pollution has become big challenge nowadays and not only affect the vegetation and human health but increases irregularities in rain budget with the situations of floods and draughts. Among varieties of major pollutants, CO_2 produces adverse effect in many ways. Specifically, global warming due to CO_2 has become the biggest menace to the life on the earth. CO_2 concentrations raise air temperature and more water vapor into atmosphere which collectively amplify greenhouse effect. Alone CO_2 causes about 20% greenhouse effect.

In order to meet the above challenge, we planned to make use of excess budge of CO_2 in atmosphere which would help in two ways:

1. **The use of excessive CO_2 in precipitation will reduce the % pollution in atmosphere.**
2. **The enhancement of precipitation by the use of CO_2 will reduce adverse situations of draughts and floods.**

MATERIAL AND METHODS-

CO_2 dissolves in water and some of it reacts with vapour molecules to make weak acid (H_2CO_3) solution at given pressure and temperature producing

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

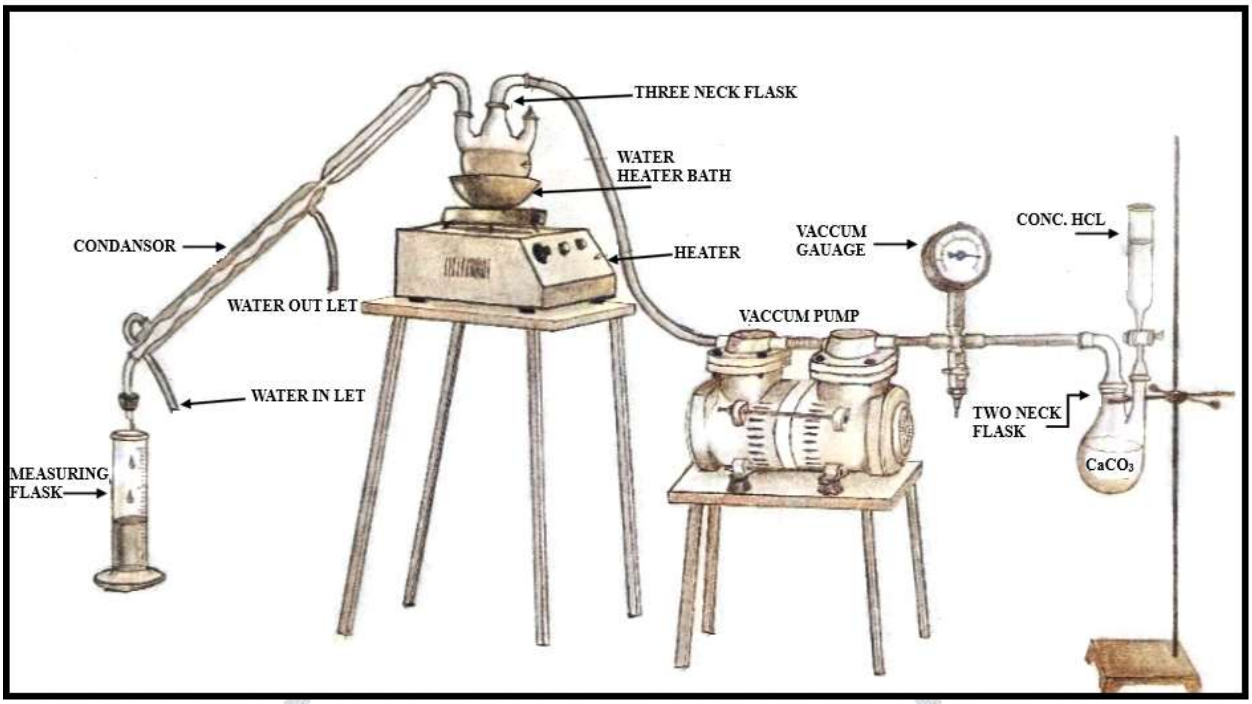
$$H_2CO_3 \longrightarrow H^+ + H\,CO_3^-$$

$$H\,CO_3^- \longrightarrow H^+ + CO_3^{--}$$

H_2CO_3 is a weak acid and it dissociates to produce H^+ ions and hydrogen carbonate ions $H\,CO_3^-$. The solubility of CO_2 is 99% and exists as the dissolved gas in H_2O. Less than 1% carbonic acid H_2CO_3 which partially dissociates to H^+, HCO_3^- and CO_3^- (R. Wiebe and V.L. Gaddy J. Am. Chem. Soc. 1940,62)

CO_2 shows solubility in water as linear function of pressure and inversely proportional to temperature. At 25 Atm pressure at 12^o C, it is 19.57 cc/gm of H_2O and at 40^o C, it is 11.62 cc/gm of H_2O but at 200 Atm pressure at 12^o C it is 39 cc/gm and at 40^o C, it is 31.7 cc/gm of H_2O.

These hydro carbonate ions and protons may act like nucleation centers for the condensation of vapour (group of H_2O molecules) in the form of the droplets of adequate mass for the shattering of rain from cloud under the influence of gravity.



Figure– I Represents the setup of experiment.

METHOD-

1. CO_2 is produced at constant rate adding concentrated acid HCl onto the powder of Ca CO_3 compound in round flask as shown in the diagram-1.
2. CO_2 is flushed into round flask of four necks by vacuum pump motor at consent pressure to get dissolved with water vapor.
3. Water vapor is produced at 100^o C by water bath heater.
4. The dissolved CO_2 in vapor is passed into condenser operated at constant ratio flow of water 10ml/second (inlet and outlet).
5. At recorded time by stop watch, condenser water was collected in to measuring flash and obtained data are tabulated in table-1.

TABLE-I: Data of condensed H_2O

S.NO.	Time recorded by Stop-Watch (Minutes)	Condensed Amount of **H_2O** with **CO_2** (ml.)	Condensed Amount of **H_2O** without **CO_2** (ml.)	Flow Pressure INCH/Hg Of **CO_2**
1	11	12±0.5	3.0±0.5	26±1.5
2	20	21±0.5	10 ±0.5	26±1.5
3	30	32±0.5	11±0.5	26±1.5

4	40	42±0.5	15±0.5	26±1.5
5	50	-	18±0.5	26±1.5

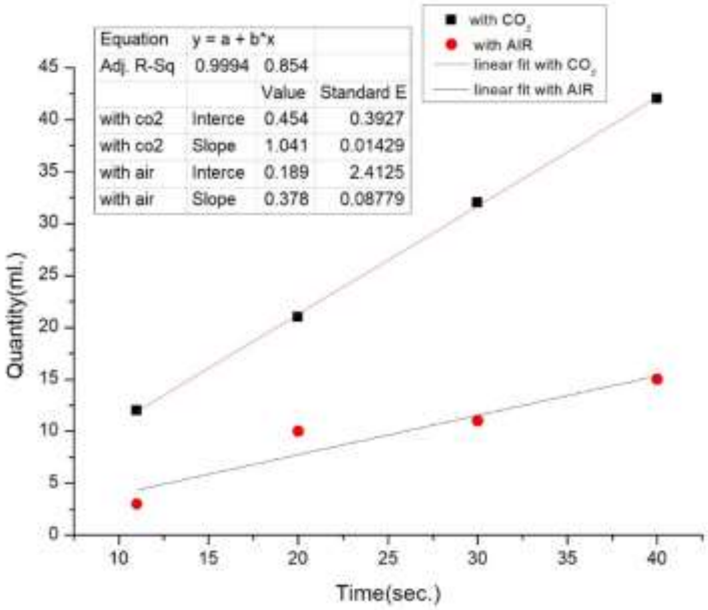


Figure-II Represents the graph of vapour condensation rate

RESULT AND DISCUSSION-

The vapour condensation rates in graph after best fitting in ORIGIN software are obtained to be

$R_{without\ CO2}$ = 0.378, and $R_{with\ CO2}$ = 1.041 ml/minute

with least square fit of chi square value of 0.9994 and 0.854 respectively. The enhanced condensation rate due to the presence of CO_2 in vapour is measured to be

$$(R_{with\ CO2} - R_{without\ CO2}) / (R_{without\ CO2}) = 1.75$$

CONCLUSIONS-

Explicitly the aim of the experiment was to know the role of CO_2 in precipitation of clouds in rainy season. Although the role of aerosols and hygroscopic NaCl in precipitation have been studied extensively in literature but to understand the individual role of some specific gas component would have an additional advantage that it is easily available and its excess budget as pollutants can be reduced in atmosphere by its use in precipitations. We measured the enhanced rate of precipitation of vapour by presence of CO_2 to be about 175% which is good enough. This information can be used in artificial rain. By drone, the CO_2 bags can be lifted up to monsoon cloud if they do not shatter and precipitate. In clouds while going up, drone bags would release the CO_2 and all

CO_2 would react with vapour to make H^+, HCO_3^- and CO_3^{--} ions. These ions are formed because of the weak hydro carbolic acid. These ions would act like nucleation centers for condensation of vapour of water under their electric fields. In order to screen H^+, HCO_3^- and CO_3^{--} ions charges a Debye multi-layers spherical shells of polar H_2O would be formed as shown in diagram -3,4,5.

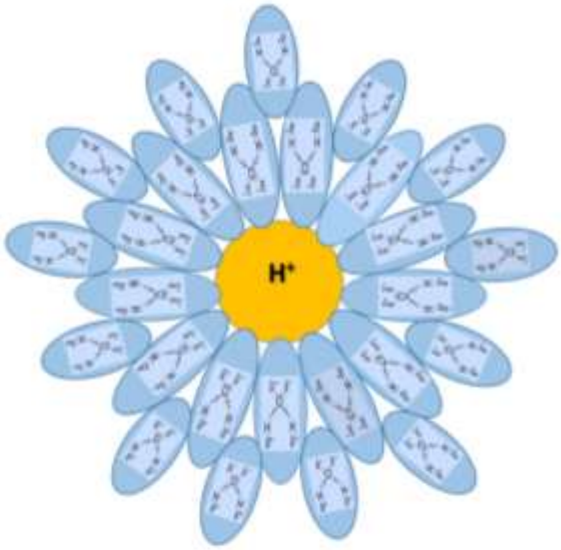


Figure-III Represents the ion H^+ with screens of spherical Debye multi-layers of polar vapour of water molecules.

Figure-IV Represents the ion HCO_3^- with screens of spherical Debye multi-layers of polar vapour of water molecules.

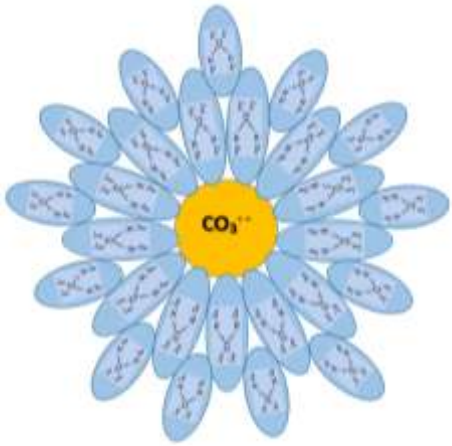


Figure-V Represents the ion CO_3^{--} with screens of spherical Debye multi-layers of polar vapour of water molecules

This would raise weight of macro molecules to form big droplets which under gravity would shatter down as rain shower. The advantage of the artificial raining with the help of CO_2 is this that there would be uniform rain everywhere without draught and flood situations and also would reduce the excess budget of CO_2 in our atmosphere in order to diminish the greenhouse effect causing global warming on our planet, the Earth.

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Declaration of competing interest-

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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