

Cloud Seeding by Non-Convectional Methods

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Abstract—Water is one of the most basic commodities on earth sustaining human life. In many regions of the world, traditional sources and supplies of ground water, rivers and reservoirs are either inadequate or under threat from ever-increasing demands on water from changes in land use and growing populations. This has prompted scientists and engineers to explore the possibility of augmenting water supplies by means of cloud seeding. This paper provides an overview of the current scientific status of weather modification activities to enhance precipitation and cost effective methods.

Index Terms—Cloud Seeding, Non- Convectional, Kite, Rokakku Kite, Mechanism, Satic Cloud Seeding, Non-Hazardous Catalyst.

1 INTRODUCTION

CLOUD seeding is a form of weather modification, a way of changing the amount or type of precipitation that falls from clouds, by dispersing substances into the air that serve as cloud condensation or ice nuclei, which alter the microphysical processes within the cloud. The most common chemicals used for cloud seeding include silver iodide, potassium iodide and dry ice. Liquid propane, which expands into a gas, has also been used. Cloud seeding is used to increase precipitation in an area, to evaporate fog and clouds to keep an area dry by precipitating out, for reducing the cloud cover, to clean out the pollution, to help put out wildfire by making it rain

When cloud seeding increased snowfall takes place when temperatures within the clouds are between -4 and 19 °F (-20 and -7 °C). Introduction of a substance such as silver iodide, which has a crystalline structure similar to that of ice, will induce freezing nucleation. In mid-altitude clouds, the usual seeding strategy has been based on the fact that the equilibrium vapor pressure is lower over ice than over water. The formation of ice particles in super cooled clouds allows those particles to grow at the expense of liquid droplets. If sufficient growth takes place, the particles become heavy enough to fall as precipitation from clouds that otherwise would produce no precipitation.

Under the guidelines of the Clean Water Act by the EPA, silver iodide is considered a hazardous substance, a priority pollutant and as a toxic pollutant. Chronic ingestion of iodides may produce skin rashes, running nose, headache and irritation of the mucous membranes. Hygroscopic seeding agents are mainly corrosive and they contribute to salting the soil.

2 CONVENTIONAL CLOUDSEEDING

Cloud seeding is a way to artificially tweak rain. It is also known by other terms such as man-made precipitation enhancement, artificial weather modification, rainmaking and so on. The technology sprays particles of salts like silver iodide and chloride on clouds using a special aircraft, rockets or from dispersion devices located on the ground. These salt particles act as a core (cloud condensation nuclei or ice-nucleating particles) which draw water vapour within the cloud towards them and the moisture latches on, condensing into water droplets leading to the formation of raindrops. The goal of cloud seeding is to alter the natural development of the cloud to enhance precipitation, suppress hail, dissipate fog, or reduce lightning.

2.1 Cloud Seeding Methods

Static cloud seeding involves spreading a chemical like silver iodide into clouds with the help of planes. The silver iodide provides a crystal around which moisture can condense. The moisture is already present in the clouds, but silver iodide essentially makes rain clouds more effective at dispensing their water.

Dynamic cloud seeding aims to boost vertical air currents, which encourages more water to pass through the clouds, translating into more rain. Up to 100 times more ice crystals are used in dynamic cloud seeding than in the static method. The process is considered more complex than static cloud seeding because it depends on a sequence of events working properly. An unexpected outcome in one stage could ruin the entire process, making the technique less dependable than static cloud seeding.

2.2 Catalyst

Introduction of the catalyst, which has a crystalline structure similar to that of ice, will induce freezing nucleation. The most common chemicals used for cloud seeding include silver iodide, potassium iodide and dry ice (solid carbon dioxide). Liquid propane, which expands into a gas, has also been used. The shell structured TiO_2/NaCl is a novel cloud seeding aerosol.

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2.3 Drawbacks

The technique is mostly used on clouds that already show early signs of rainfall, so it is not known if it actually causes rain and it is very expensive. It uses chemicals which can harm the environment especially plants and animals. Some of them such as silver iodide, lead iodide and zinc chloride can cause adverse ecological effects in both aquatic and terrestrial systems if the content exceeds a certain threshold and if it lasts for a long time.

3 NON-CONVENTIONAL CLOUDSEEDING

For Non-conventional cloudseeding we use traditional methods with modern mechanism. In traditional method use some special kites having remarkable properties.

3.1 Types of Kite

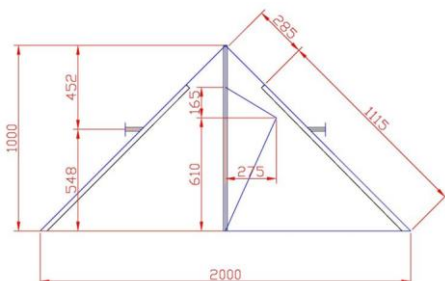
The Rokkaku kite is a traditional six-sided Japanese Fighter Kite. Traditionally, it is made with bamboo spars AND WASHIpaper. The structure is a vertically stretched hexagon with a four-point bridle. One bamboo runs from tip to toe, and there are two cross-spars. Flown on a taut string, the kite is stable and rises rapidly. When the line is released, the kite tumbles until tension is put on the line, at which point it takes off in the direction of the spine.



Fig.1.Rokakku Kite

Area of Rokakku Kite is simply calculated by adding the area of all four triangle and two rectangle shapes of the kite.

The Delta Kite is a Sport kites can be designed to fly in a wide range of conditions. Most standard kites fly best in winds from 1.5 to 4 m/s (5.4 to 14 km/h; 3.4 to 8.9 mph). High wind kites can be flown in very strong winds of 14 m/s (50 km/h; 31 mph) or more. There are kites made from the lightest materials that can be flown in the slightest breeze or even indoors. The maximum height attend by the delta kite is around 4879.54 meters.



Area of Delta Kite is simply calculated by adding the area of all triangle shapes of the kite.

Weight lifting capacity or coefficient of lift of both kites can calculate by

$$Cl = \frac{2 \times W}{\rho \times A \times V^2}$$

3.2 Sensors

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data. A thermocouple is comprised of two conductors, each made of a different type of metal, that are joined at an end to form a junction. When the junction is exposed to heat, a voltage is generated that directly corresponds to the temperature input. Thermocouples are generally inexpensive, as their design and materials are simple.

Humidity Sensors are very important devices that help in measuring the environmental humidity. Technically, the device used to measure the humidity of the atmosphere is called Hygrometer. Humidity Sensors or Hygrometers can be classified based on the type of humidity it is used for measuring i.e. Absolute Humidity (AH) sensors or Relative Humidity (RH) sensors.

3.3 Mechanisms

The mechanism works on WhitWorth Quick Return Mechanism. The hollow spray is their which is operated with the use of sensors like temperature sensor and humidity sensor as the it gets over the desired set value of temperature and humidity the motor which is placed and programmed on ArduinoATmega 328P accordingly starts rotating and then the complete action of quick return mechanism takes place.

A quick return mechanism is an apparatus to produce a reciprocating motion in which the time taken for travel in return stroke is less than in the forward stroke. It is driven by a circular motion source (typically a motor) and uses a system of links with three turning pairs and a sliding pair. The position of the arm can be found at different times using the substitution of Euler's formula

$$e^{i\theta} = \cos \theta + i \sin \theta$$

For the analysis of the velocity of the disc relative to the arm is the angular velocity of the disc

$$\omega = v/r$$

In second mechanism we use aerosol flare. These flares produce small salt particles of the uniform size of 0.5 micrometer. The flares are used for seeding in the updraft areas below the base of convective clouds. The initiation device can be initiated by giving an electrical pulse. In turn initiation device will

be initiating the pyrotechnic composition, which gives smoke with pressure. The hygroscopic material used in the composition will get dispersed in the atmosphere through the smoke which acts as nuclei for precipitation.

4 EXPECTED OUTCOMES

Weight carrying capacity of Rokakku Kite is seen more among the other kites of same category. Velocity of air is generally found 2 m/s to 4.5 m/s in favourable conditions. With consideration of density of air 1.225 kg/m^3 we can plot results as shown in fig.3.

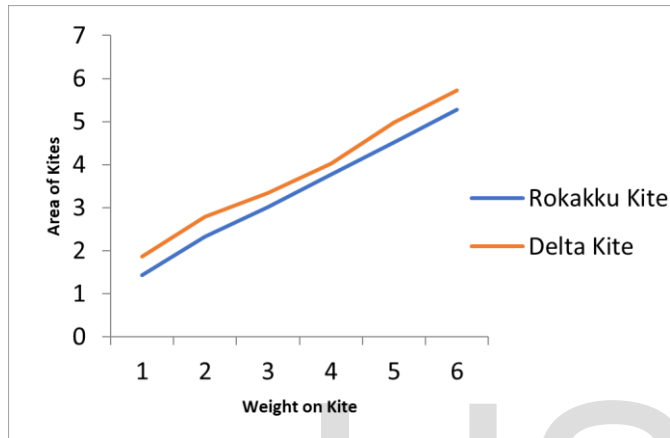


Fig.3.graph

After some evaluation of cloud seeding effectiveness, it is found not to be foolproof as of the moment. The technique is mostly used on clouds that already show early signs of rainfall, so it is not known if it is actually the cause of rain. Plus, the high cost of doing it is not even believed to be justifying its effectiveness.

As per CAG report the costing of cloud seeding in India is up to 2-4 corers. By using Non-convectonal Methods for cloud seeding we can decrease the cost during this process.

3 MERITS OF NON-CONVECTIONAL CLOUD SEEDING

One big benefit of cloud seeding is being able to create rain in regions that undeveloped and deprived from government policies. By using the technique, farms can yield more crops due to the fact that farmers will be able to grow plants in areas that might not have supported them in the past. This means cloud seeding can get rid of famine in the future.

Aside from agriculture, it is stated above that tourism would be boosted by cloud seeding. Dry, arid places that are previously considered as inhospitable would be transformed into desirable vacation spots, bringing in a flood of foreign currency into the economy, which then circulates among the local residents improving their living conditions. Given that it would prevent famine and boost tourism, cloud seeding may well bring economic improvements to developing countries.

4 CONCLUSION

Cloud seeding by traditional method and by using less hazardous chemicals we tend to find same precipitation. One of

the problems with proving that cloud seeding is effective is that it is hard to measure precipitation changes due only to seeding versus changes due to natural factors. In general cloud seeding experiments have shown that a 5% to 20% increase in precipitation can be expected from a well-designed and properly conducted cloud seeding project. We can make Cloud Seeding for Economical by using Kites.

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