Aviation Means of Influencing Clouds

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ABSTRACT

This article extensively covers high-quality and mobile ways of influencing clouds with the effective use of aviation, ways to combat hail that threatens to cause major harm to both the state economy and human health, as well as some types of technical means used to solve this problem.

KEYWORDS: *clouds, reagent, aviation, precipitation, plane, pyrotechnic cartridges, drone probe, hex copter, generator.*

One of the most effective and widespread in the work on the impact on clouds is the aircraft method of delivering reagents to the clouds.

This method of exposure is characterized by high mobility, the possibility of introducing a reagent into the required cloud zone in the required quantity with sufficient accuracy and prompt response in the process of impacting a rapidly changing meteorological situation, and there is no need to create special infrastructure in the area where this task is performed.

Airborne impact methods are most successfully used in works on artificial regulation of precipitation, and in some countries for hail control [1].

In anti-hail work, aviation technology is used mainly for seeding feeder clouds that feed the hail cloud. Sowing is done under the base or at the top of the cloud. In the 1980-90s, in the CIS countries, aircraft technology for cloud seeding was mainly used in works on artificial regulation of precipitation. To carry out these works, a number of aircraft were created: aircraft meteorological laboratories of the State Committee for Hydrometeorology Il-18, An-12, An-26 «Cyclone», aircraft meteorological laboratories Yak-40, as well as An-30 aircraft «Meteoprotection», created for meteorological protection.

All aircraft were equipped with ASO-2I firing systems for firing PV-26 squibs and KDS-155 systems for firing PV-50 squibs.

In addition, An-2 aircraft equipped with SAG-P aircraft aerosol generators of 50 mm caliber were widely used in the work on the artificial increase in precipitation in the fight against forest fires. In the nineties of the last century, this entire fleet was lost, and starting from the 2000s, Il-18, An-12, An-26 aircraft, as well as experimental aircraft An-32, Su-30, began to be used in meteorological protection., civil aviation aircraft, An-30, An-28, M-101T Gzhel, which were retrofitted for the duration of the work with special equipment and technical means of influencing clouds. Abroad (Australia, Israel, USA, South Africa, Mexico, Thailand) DC-6, Cessna, Airtrack, Porter, Apache and others are used to actively influence clouds.

These aircraft are equipped with the necessary means for introducing reagents into the clouds and equipment for measuring the navigation characteristics of the flight, thermodynamic, radar and radiometric parameters of cloudiness, optical and microphysical characteristics of the atmosphere and clouds.

Pyrotechnic cartridges and ice-forming aerosol generators. The creation of a pyrotechnic method for producing artificial ice-forming aerosols served as a powerful impetus for the development of means of active influence and formed the basis for the development of most modern methods of influencing clouds.

As part of the development of this method, aircraft technical means of influence were created:

- squibs fired from an aircraft that carry out vertical seeding of clouds;
- aircraft generators of ice-forming aerosol, carrying out seeding of clouds along the flight path.

In the process of exposure, the squibs are fired at the moment the aircraft crosses the top of the cloud or flies over it [2], and the aircraft generator is turned on when the aircraft flies directly in the cloud or under its base, when ice-forming aerosol is introduced into the cloud by ascending flows.

а) *б)* *в)*

American aircraft aerosol generators "ICE-HBIP" (a) and "ICE-EJ" (b) and Bulgarian aerosol generators "Sky Clear 1000, 500, 150 and 30" (c)

Among the Russian means of influence, it should be noted the SAG-P aircraft aerosol generators developed before 1983 and the PV-26 pyrotechnic cartridges equipped with a pyrotechnic ice-forming composition with a 2% AgI content.

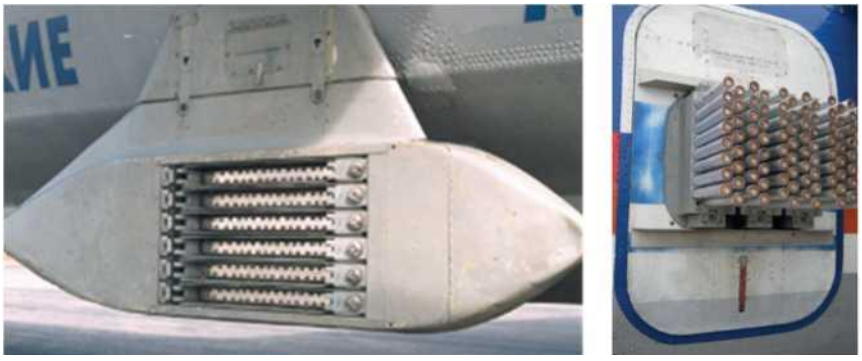
In 2000, with the participation of the Agency, a new pyrotechnic composition AD-1 [3] was developed with an 8% content of the active reagent AgI, with increased indicators for the yield of active nuclei (1013 g-1) and for the threshold of crystallizing activity (minus 6 °C).

Based on it, according to the terms of reference of the ATTECH Agency at the Cheboksary Production Association named after. IN AND. Chapaev, squibs PV-26-01, PV-50M and generators SAG-PM and SAG-26 were created.

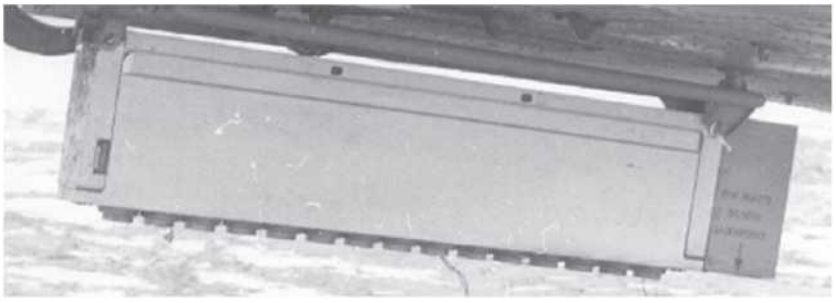
а *б* *в* *г*

Aircraft aerosol squibs: PV-26-01 (a), PV-50M (b) and generators: SAG-Pm (c), SAG-26 (d)

For the impact of squibs and generators, multi-barrel launchers (cassettes) ASO-2I or UV-26 (Fig. 3.15) and KDS-155 and KUSAG-PM are used, installed on aircraft such as An-26 (An-30), Il-18, An-12, An-28.



ASO-2I system with PV-26-01 squibs on An-26 (An-30) aircraft (a) and UV-26 system with SAG-26 generators on An-28 aircraft (b)



Aircraft device KUSAG-PM on the An-2 aircraft

The KUSAG-PM device is a modernization of the KUSAG-P device (development of the Krasnodar branch of the Research Institute of the Pankh of the MGA according to the terms of reference of the GGO).

The KUSAG-PM device allows placing up to 30 SAG-PM generators on the An-2 (An-3, TVS-2DT) aircraft. Flight tests of the SAG-PM generators were carried out on the An-2 aircraft in 2005 in the Stavropol Territory.

Aviation generators of fine ice particles on liquid nitrogen. The first use of nitrogen generators in carrying out active impacts on clouds from an aircraft dates back to the mid-80s, when an aircraft generator of fine ice particles on liquid nitrogen (GMCHL-A) was developed in the Central Administrative District and began to be used in experimental work on artificially increasing precipitation.

The GMCHL-A generator provides a maximum reagent consumption of 30 g/s with a refilled mass of liquid nitrogen of 96 kg, power consumption at a supply voltage of 27 V - no more than 162 W.

Realizing the need for nitrogen generators, during large-scale work to improve weather conditions in megacities, on the initiative and at the expense of the ATTECH Agency, more than 10 quick-detachable nitrogen generators were manufactured, which were equipped with aircraft of various types (An-12, Il-18, An-72 , An-26, An-30, An-28, M-101T Gzhel). Installation of the GMCHL-A generator on board an aircraft (helicopter, airplane) does not require special design modifications. The design of the generator allows the installation of a pylon with a nozzle on technological hatches or on a porthole plug.

а б

Aircraft generator of fine ice particles GMCHL-A (a), ground check GMCHL-A on AN-12 aircraft (b)

If necessary, to ensure the operation of the GMCHL-A generator during the entire flight, an additional number of Dewar vessels with nitrogen of the SK-40 type are loaded on board the aircraft.

Aircraft nitrogen generators can be installed on aircraft with both pressurized and non-pressurized cabins.

An important argument in favor of the use of nitrogen generators in production work on active exposure is that the cost of exposure to clouds using liquid nitrogen is significantly lower than the cost of exposure to granular carbon dioxide.

Prospects for the use of UAVS during work on aviation impact (AI) using ground-based aerosol generators.

The efficiency of work on AW to clouds using ground-based aerosol generators largely depends on the availability of information on the vertical profiles of wind speed and direction in the atmospheric boundary layer. Promptly obtained information about the wind profile in the atmospheric boundary layer is necessary to determine the locations of generators and their operating modes both at the planning stage and to control the impact results.

Using the numerical model Seed Disp developed by the Agency, based on this information, the propagation of an aerosol cloud of ice-forming particles, which is formed as a result of the operation of ground-based aerosol generators, is simulated [4]. As a result of the analysis of existing methods and means of atmospheric wind sounding, the Agency created a mobile system for obtaining data on the vertical wind profile in the atmospheric boundary layer using a dronesonde dropped from an unmanned aerial vehicle (UAV) based on the DJIS900 hex copter and a ground-based stations for receiving information.

a) dronesonde b) DJIS900 hex copter

Drawing conclusions from the above, it should be noted that with the effective and high-quality use of these methods and means, it becomes possible to promptly and modern artificial impact on city-forming clouds, as well as timely protection of crops, objects of the economy of human health and the prevention of accidents, due to hail.

Literature:

1. T. V. Krauss, A. A. Sinkevich, N. E. Veremey, and Yu. A. Dovgalyuk, Meteorology and Hydrology. M.: - 2009. 200 p.
2. Dubinin B.N., Kaplan L.B., Nesmeyanov P.A., Ekba Ya.A., Pashkevich M.Yu. and others: A method of influencing supercooled clouds from an aircraft. RF patent for the invention. M.: 1995-203s.
3. Nesmeyanov P.A., Dyachenko Yu.D., Dubinin B.N., Lantsov A.V., Korneev V.P., Ponosov V.S. and others: Pyrotechnic composition for active influence on supercooled clouds and fogs. RF patent for the invention. M.: 2000-185s.
4. Petrunin A.M., Korneev V.P., Koloskov B.P., Chastukhin A.V., Bychkov A.A., Kim N.S., Sergeev B.N. Scientific journal of the North Caucasian Federal University “Science. Innovation. Technologies". 2016, No. 3. - pp. 69-82