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Atmosphere Self-Rectification from Aerosols

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ABSTRACT

"Self-rectification's velocity", dry "sedimentation" and "washing" by atmospheric sediments. For different climatic regions and seasons, the values of the developed parameter that is of great importance for ecologically sound atmospheric protection.

Key words: air pollution, atmospheric aerosol, atmospheric protection.

All types of industrial activities require following the norms of air basin protection, preserving its pollution and degradation. At the same time, the environment protection itself constitutes an industrial activity, so the separation of these activities is symbolic. Nevertheless, let follow the tradition; thus the above-mentioned industrial and protective activities will develop and become perfect due to scientific progress and the design of programmes aimed at reducing the pollution and improving environmental quality. The occurred political changes and economic development caused by them have altered the ways of enhancement of such programmes. For such country as Georgia it is impossible to carry out the similar programmes by its own sources without transnational economic instruments such as pollution permits tradable at the international level environmental cost - benefit analysis, large investments into special programmes Development of common economic area of countries of the Black Sea basin an increase of integration processes makes possible to carry out a number of political and economical measures. Common industries activities connected with joint enterprises require creating unified regulatory mechanisms. Man juridical, technological, economical and political regulatory mechanisms permitting to reduce harmful anthropogenic influence on environment are based on stand arts adopted by the state committee on environment protection.

Development of common economic area of countries of the Caucasus and Black Sea basin an increase of integration processes makes possible to carry out a number of political and economical measures. Common industries activities connected with joint enterprises require creating unified regulatory mechanisms.

The solid or liquid microscopic particles, suspended in atmosphere differ from atmospheric dust having long "life" time in atmosphere. These particles constitute atmospheric aerosols. Their chemical and dispersive composition has a wide range of changeability recently a lot of researches have been dedicated to the study of physicochemical qualities of atmospheric aerosols. It was conditioned by if climatic and ecological great significance. The results of research of radioactive and no radioactive aerosols in atmosphere are summarized in many articles and monographs, including in Georgia [1-9]. The research results of atmospheric aerosolise component for Transcaucasia are summarized in our work. Here, also, was showed the "climatic stability" of atmosphere's lower layer **"self-rectification's velocity"**. The methodology of its experimental definition became possible after the determination of simple gauzed manifold catching effectiveness which is used widely in Georgian Hydrometnetwork i.e. the effectively of atmospheric sediment collectors.

In the process of theoretical analysis, we have found the total index for the atmospheric aerosol summary beta-radioactivity. That gives us the possibility tot learn integrally the dynamics of atmospheric **"self-rectification's velocity"** rectification for various aerosols, which are different in dispersion and composition. We defined average velocities of self-rectification for the lower troposphere in months for big

towns of the Volga region and the Caucasian Daily data about sediments, which were collected during 10 years by gazed manifolds on the surface of ground, were worked out in approximately forty thousands of measurements and the same measurement about aerosol's concentration in the preground layer. The simple analysis of the measurement shows that any relation of the stream's admixture to its concentration is the velocity. The physical essence of this velocity is in the given unity of time, given corpulence of lower layer of atmosphere is completely cleared from the aerosol.

The geophysical essence of obtained characteristics is:

- It comes out, that seaside regions are characterized by high velocities of **"self-rectification's velocity"**, compared with regions, which are far from the sea (Tbilisi, Yerevan, and Rostov).
- Conventionally, we can say that for the given region there is "three types" (groups) of atmospheres **"self-rectification's velocity"** according to the following gradation:
- Continental (Tbilisi, Yerevan) wet velocities up to ~ 0.5 transitional up to 2.0 Km/24 hours (Rostov):
- And seaside (Volgograd, Astrakhan, Sokhumi, Baku), where velocities exceed 2.4 Km/24 hours.

Note that according to the data of the aircraft measurements of the vertical distribution of the radon decay products and solid aerosols in the lower troposphere that average rate of deposition of aerosols with a radius from 0.35 to > 2.0 μm was 0.21 - 0.45 cm/sec (0.18-0.49 Km/24 hour) [6].

Various kinds of admixtures (solid, liquid or gaseous) getting in atmosphere stay there for definite time. It depends on many processes: the turbulent calculation, sedimentation or coagulation with particles of clouds, their washing by atmospheric sediments. During the study of geo-ecological aspects of the atmosphere soiling, processes of the admixtures sedimentation from the atmosphere are divided conventionally into two groups: dry "sedimentation" and "washing" by atmospheric sediments ("dry" and "wet" sedimentation). The conventionality of such division of clear, if we go deep into physical and chemical mechanisms of processes, which go on in the atmosphere. Simple analysis shows us, that gravity and elementary forces as well as the turbulence, moisture and density of gas (in this case different layers of the atmosphere) always take part in each process (in the case of loaded particles). In spite of the conventionality of such division, it gives us the possibility to reveal regional geophysical peculiarities in processes of the same admixture (or pollution's) sedimentation from the atmosphere. It's a well-known fact, that during the sedimentation of aerosolise particles from the atmosphere, there are much more "wet" sediments, than "dry" ones, but it's difficult to make the correct numerical estimation, in spite of huge number of experimental and theoretical data.

The whole region is characterized by:

Annual washing:

Cold season: $10.0 \cdot 10^{-5}$ sec^{-1};

Warm season: $4.12 \cdot 10^{-5}$ sec^{-1};

Average annual: $7.03 \cdot 10^{-5}$ sec^{-1}.

For comparison, we note that in the works [9-13] give the data about the processes of the accumulation of natural radioactive aerosols in the convective clouds, and also about the values of the parameter of the washing out of aerosols with the cloud drops Λ (Λ of order 10^{-4} sec^{-1}). According to the data of laboratory experiments [8] the values of the coefficient of the washing out of aerosols by a diameter of about 1 μm by the drops of fog by diameter about 20 μm composed (9-23) $\cdot 10^{-4}$ sec^{-1}. For drops of water with diameter of approximately 70 μm it is obtained, that with the washing out of aerosols with diameter about 0.6 μm the value $\Lambda \approx 2.5 \cdot 10^{-4}$ sec^{-1}, and for aerosols with diameter about 4.2 μm, $\Lambda \approx 24 \cdot 10^{-4}$ sec^{-1} [8]. Laboratory experiments in the cloud chambers of the M. Nodia Institute of Geophysics were carried out [14,15].

The hypothesis of "ergoannualitical" can be approved by the prognostical modelling of admixtures content and composition. The revealing of such dependence constitutes the special problem. We showed that the characteristics of statistical fields of pollution do not satisfy this condition and their self-correlation and interstructural functions are non-statistical and demands the appliament of other statistical model [1, 2].

We have worked out the physical and statistical method of air pollution prognosis for cold and warm seasons for the city with average population ranges of 1-3 mln · inhabitants. The scheme is tested and reported at many scientific forums and meetings. Real prospects exist to better this number of experimental parameters for different conditions of the Black Sea regions. That should be done under the international programme. The scheme of prognosis is substantially précised by introduction of an inertial parameter Pi-1 (for the previous day), the reproducibility of such scheme is about 75-80%, that allows effectively adjust the loadings on the atmosphere and environment in whole during the unfavourable meteorological conditions and realize the principles of ICZM (Integral Costal Son Management).

Studies of the last decade give us the opportunity to introduce the number of new experimental parameters that allow describing the process of admixtures' sedimentation from the lower layers of atmosphere [1-3]. Calculates according the long-term experiments studying the introduced climatologic parameter characterizing the selt~c1eaning ability of lower layers of atmosphere for different regions and speed of cleaning. As one can see given parameters differ twice or three times, that is substantial for standardization of limits of exhausts set up within the ranges of atmosphere protection, the ICZM scheme. It should be mentioned that even in the period of the Second World war the American scientists outlined the physical meaning of the given parameter, that may be stated by simple analysis of the dimension ratio of admixture's flow value on the earth surface off the lower atmospheric layers per unit of time to concentration is velocity and is physically equal to the atmospheric layer that is cleaned per unit of time. Long-term investigations proved that this value is climatologically stable and may be used in practice for standardization of toxic exhausts in atmosphere.

Processes of atmosphere self-rectification are much more intensive, our estimation = $7 \cdot 10^{-5}$ sec^{-1} is much higher than the results, which are given by other researchers.

It is noticeable that estimations, gived for each season, warm and cold, twofold differ from each other and a how correctness of the existing mechanisms of atmosphere self-rectification.

Given experimental estimations, give us the possibility to use scientific conditioned planning measures for atmosphere protection.

Thus, the state independence and free market economics, made actual not only creation of juridical basis, but international unification as well. Climatic unification may be made according the following scheme 1) coastal regions with high humidity, 2) regions with average humidity, 3) highlands, 4) regions with low humidity and deserftIike climate. Such rejoining for standardization needs sources and a lot of time.

In this sphere, the international cooperation may be very effective. On the other hand, from the standpoint of the international unification of the standards there is also a need to consider ways in which economic instruments may be employed as policy tools for improving atmosphere quality, especially in the most cost effective manner, possible under free market economics that will improve regional economic situation.

References

[1] Tsitskishvili M.S. Prognosis of Atmospheric Pollution of Large Cities and Industrial Centres Located in Caucasian Region. IH All union conference on Aerosols - M. SU GKNT, 1977, pp. 65-66.

[2] Tsitskishvili M.S. Air Pollution and Prognosis of Expected Increase of Some Harmful Admixtures in Tbilisi Region. Works of Caucasian Inst. of Hydrometeorology, is. 66-72. Hydromeotizdat. L., 1980, pp. 3-17.

[3] Tsitskishvili M.S. Integrated characteristics in models aerosol transfer in atmosphere. ISTC Russian – Canadian Workshop "Modelling Atmospheric Dispersion of Weapons Agents. June 19-21, 2006, Moscow, pp. 102 -104.

[4] Tsitskishvili M.S., Ninua T.L., Mikeladze M.O. Regional parameterization by atmospheric transfer for reduction radioactive pollution. "Radiological and agroecological Researches", v. VI. The complete works consist of the materials of the International Conference devoted to XXX Anniversary of the Institute establishment, ISSN 1512-2786, Tbilisi, 2009, pp.181-185.

[5] Kozmanashvili A., Liparteliani M., Tsitskishvili M., Bibiluri E.. Radiational problems about the security of the production in conditions of contemporary technogenesis in the Agroecosphere of Georgia. Int. Conference "Protection of Agrobiodiversity and Sustainable Development of Agriculture", ISSN 978-9941-17-143-7, November 24 –25, 2010, Tbilisi, Georgia, pp. 228 – 231, (In Georgian).

[6] Styra B., Amiranashvili A. Aerosol Distribution above Georgia Investigations. Trans., Institute of Physics of the Academy of Sciences of the Lithuanian SSR, Atmospheric Physics, ISSN 0135-1419, v. 8., "Mokslas", Vilnius, 1983, pp. 18-24, (in Russian).

[7] Amiranashvili A.G., Gzirishvili T.G., Kartsivadze A.I., Nodia A.G. Aircraft investigations of the distribution of aerosols in the lower troposphere, Proc. 9th Int. Conf. on Atmospheric Aerosols, Condensation and Ice Nuclei, Budapest, Hungary, 3-8 September, v.1, 1984, 148-153.

[8] Amiranashvili A., Gzirishvili T. Aerosols and Ice Crystals in the Atmosphere. Tbilisi, Metsniereba, 1991, 113 p., (in Russian).

[9] Amiranashvili A., Amiranashvili V., Chochishvili K., Kirkitadze D. The Distribution of Aerosols Over the Georgian Territory in the Lower Troposphere, Journal of Georgian Geophysical Society, ISSN 1512-1127, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v. 8 B, 2003, pp. 70-75.
[10] Styro B., Amiranashvili A., Gamkhitashvili L., Khundzua T. On Vertical Non-Stationary Natural Radioactivity Distribution in Cumuli Clouds. Trans., Institute of Physics of the Academy of Sciences of the Lithuanian SSR, Atmospheric Physics, ISSN 0135-1419, v. 5., "Mokslas", Vilnius, 1979, pp. 18-24, (in Russian).
[11] Styro B., Amiranashvili A. Some Results of the Investigation of Cumuli Clouds Natural Radioactivity. Trans., Institute of Physics of the Academy of Sciences of the Lithuanian SSR, Atmospheric Physics, ISSN 0135-1419, v. 5., "Mokslas", Vilnius, 1979, pp. 25-42, (in Russian).
[12] Styro B., Amiranashvili A. Investigation of the Natural Radioactivity of Cumuli Clouds in the Process of their Development and Disintegration. Trans., Institute of Physics of the Academy of Sciences of the Lithuanian SSR, Atmospheric Physics, ISSN 0135-1419, v. 5., "Mokslas", Vilnius, 1979, pp. 42-50, (in Russian).
[13] Styra B., Amiranashvili A. On the Cloud Drops Radioactivation. Trans., Institute of Physics of the Academy of Sciences of the Lithuanian SSR, Atmospheric Physics, ISSN 0135-1419, v. 7., "Mokslas", Vilnius, 1981, pp. 25-29, (in Russian).
[14] Amiranashvili A.G., Bliadze T.G., Chiabrishvili N.G., Gzirishvili T.G., Kirkitadze D.D., Nodia A.G., Odisharia M.A., Okujava A.M. Laboratory modelling of the transformation of microphysical and electrical properties of artificial water fogs, Proc.1st Int. Conf. on Fog and Fog Collection, Vancouver, Canada, July 19-24, 1998, pp. 333-335.
[15] Amiranashvili A., Bliadze T., Chiabrishvili N., Chikhladze V., Gzirishvili T., Kirkitadze D., Nodia A., Odisharia M., Okujava A. Complex for laboratory modelling of microphysical and electrical properties of aero-disperse formations, Proc. Int. Conf. Dedicated to Memory of Prof. A. Sutugin, Moscow, Russia, June 26-30, 2000, pp. 54-55.

ატმოსფეროს თვითგაწმენდა აეროზოლებისაგან

მ. ციცქიშვილი

რეზიუმე

„ატმოსფეროს თვითგაწმენდის სიჩქარე", მშრალი გამოლექვა და ნალექებით გამორეცხვა. სხვა და სხვა კლიმატური რეგიონისა და სეზონისათვის განსაზღვრულია შემუშავებული პარამეტრის მნიშვნელობები, რასაც უდიდესი მნიშვნელობა აქვს ატმოსფეროს ეკოლოგიურად დასაბუთებული დაცვისათვის.

Самоочистка атмосферы от аэрозолей

М.С. Цицкишвили

Резюме

„Скорость самоочистки атмосферы", сухое оседание и вымывание атмосферными осадками. Для разных климатических регионов и сезонов определены величины разработанного параметра, что имеет большое значение для экологически обоснованной защиты атмосферы.