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Contemporary issues in ensuring biological safety during disposal of biological wastes of animal origin by incineration in the Russian Federation

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SUMMARY
Animal management and breeding as well production, transportation, preparation, and processing of animal products and raw material result in generation of a considerable amount of biological wastes being a source of biological contamination of the environment and a clear threat to human and animal health. The animal biowaste incineration units are high threat facilities and require constant surveillance and control. Collection and analysis of data provided by the RF veterinary executive authorities were performed to objectively reflect the actual situation of the biological waste incineration facilities in the RF Subjects and to create a holistic view on the problem of interest in the country. The following parameters were analyzed: their number, type (stationary and mobile), type of ownership, location, availability of the certificate and highly-qualified specialists serving the biological waste incineration equipment as well as the availability of such facilities in the RF Subjects as for January 1, 2021. The analysis demonstrated that 4,459 biowaste incinerators were registered in the country. Most of these units are stationary and they belong to establishments involved in farm animal keeping, animal product processing, production and storing. Such equipment is mostly serviced by non-qualified staff ignorant of the technical characteristics and operating principles of this equipment. Almost one third of these units in the country are home made that is why their use does not guarantee complete destruction of biological wastes and pathogen inactivation. It was also revealed that the procedure for the incineration of biological waste of animal origin using home made incinerators is not legally fixed in the country. The results obtained show that the situation of the animal biowaste incineration in the Russian Federation is quite complicated.

Keywords: disposal, destruction, biological wastes of animal origin, animal biowaste incinerators, home made incinerator, cremating furnace, incinerators

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Актуальные аспекты обеспечения биологической безопасности при сжигании биологических отходов животного происхождения в Российской Федерации

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РЕЗЮМЕ

В процессе содержания и разведения животных, а также при производстве, транспортировке, заготовке, переработке продуктов и сырья животного происхождения образуется значительное количество биологических отходов, которые являются источником загрязнения окружающей среды и создают реальную угрозу здоровью человека и животных. Установки по сжиганию биологических отходов животного происхождения являются объектами повышенной опасности и требуют постоянного наблюдения и надзора. Для объективного отражения реальной ситуации с объектами сжигания биологических отходов в субъектах Российской Федерации и формирования целостного представления о рассматриваемой проблеме в стране был проведен сбор информации и проанализированы данные, предоставленные органами исполнительной власти субъектов Российской Федерации в области ветеринарии. Рассмотрены такие показатели, как количество, вид (стационарные, мобильные), форма собственности, расположение, наличие сертификата и квалифицированных специалистов, обслуживающих установки для сжигания биологических отходов животного происхождения, а также обеспеченность субъектов Российской Федерации данными объектами по состоянию на 1 января 2021 г. Анализ полученных первичных данных показал, что в стране зарегистрировано 4459 объектов сжигания биологических отходов животного происхождения, основная часть которых составляет стационарные установки, находящиеся в ведении предприятий, занятых содержанием сельскохозяйственных животных, а также переработкой, производством и хранением животноводческой продукции. В большинстве случаев обслуживание данных объектов осуществляет неквалифицированный персонал, который не владеет знаниями о технических характеристиках и принципах работы используемых установок. Почти треть установок по сжиганию биологических отходов животного происхождения в стране непромышленного изготовления, поэтому их использование не гарантирует полного сгорания биологических отходов и инактивации патогенов. Также выявлено, что в стране законодательно не закреплен порядок проведения сжигания биологических отходов животного происхождения в трупосжигательных печах. Полученные результаты исследования свидетельствуют о том, что в Российской Федерации сложилась напряженная ситуация в сфере сжигания биологических отходов животного происхождения.

Ключевые слова: утилизация, уничтожение, биологические отходы животного происхождения, объекты по сжиганию биологических отходов животного происхождения, трупосжигательные печи, крематоры, инсинераторы

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INTRODUCTION

A great number of biological wastes of animal origin including dead animals and birds, aborted and stillborn fetuses, condemned materials generated during veterinary and sanitary inspection at slaughterhouses, meat and fish processing plants, markets, sales facilities and other facilities are accumulated at establishments and backyard farms in the RF Subjects [1–4]. Decontamination of biological wastes of animal origin is critical for insurance of animal disease freedom in the country and its territories – RF Subjects [5, 6].

According to the RF law biological wastes of animal origin are decontaminated using three methods: disposal at rendering plants involved in meat and bone meal production; decontamination in biothermal pits; destruction by burning in animal biowaste incinerators, such as home made incinerators, cremating furnaces, incinerators. It is forbidden to bury the animal biowaste in the ground, throw into the trash cans, woods, ravines, water bodies as well as send to landfills or dumping grounds [1, 6–8].

Outbreaks of animal infectious diseases present serious problems for the State Veterinary Service of the RF Subjects. The key element of the successful response to the disease is the proper disposal and destruction of the dead animals and birds that died or were seized during the outbreak. Their appropriate and effective disposal can prevent and decrease the further pathogen spread including zoonosis agents [9–11].

Outbreaks of avian influenza, ASF and rabies have been reported during the last decade in the Russian Federation. Under conditions of the disease occurrence animal carcasses, biological materials and animal products contaminated with the disease agents shall be incinerated. Incineration of hundreds and sometimes thousands of carcasses is a complex technical task the solution of which requires the involvement of significant technical, human and financial resources.

Today two major methods of animal biowaste incineration are used.

The first one involves the use of special units that ensure high quality incineration of biological waste by equipping incinerators with special burners and afterburners, as well as an exhaust gas purification system and heat exchange equipment. The assembly and erection of these units take quite a long time, which is unacceptable under

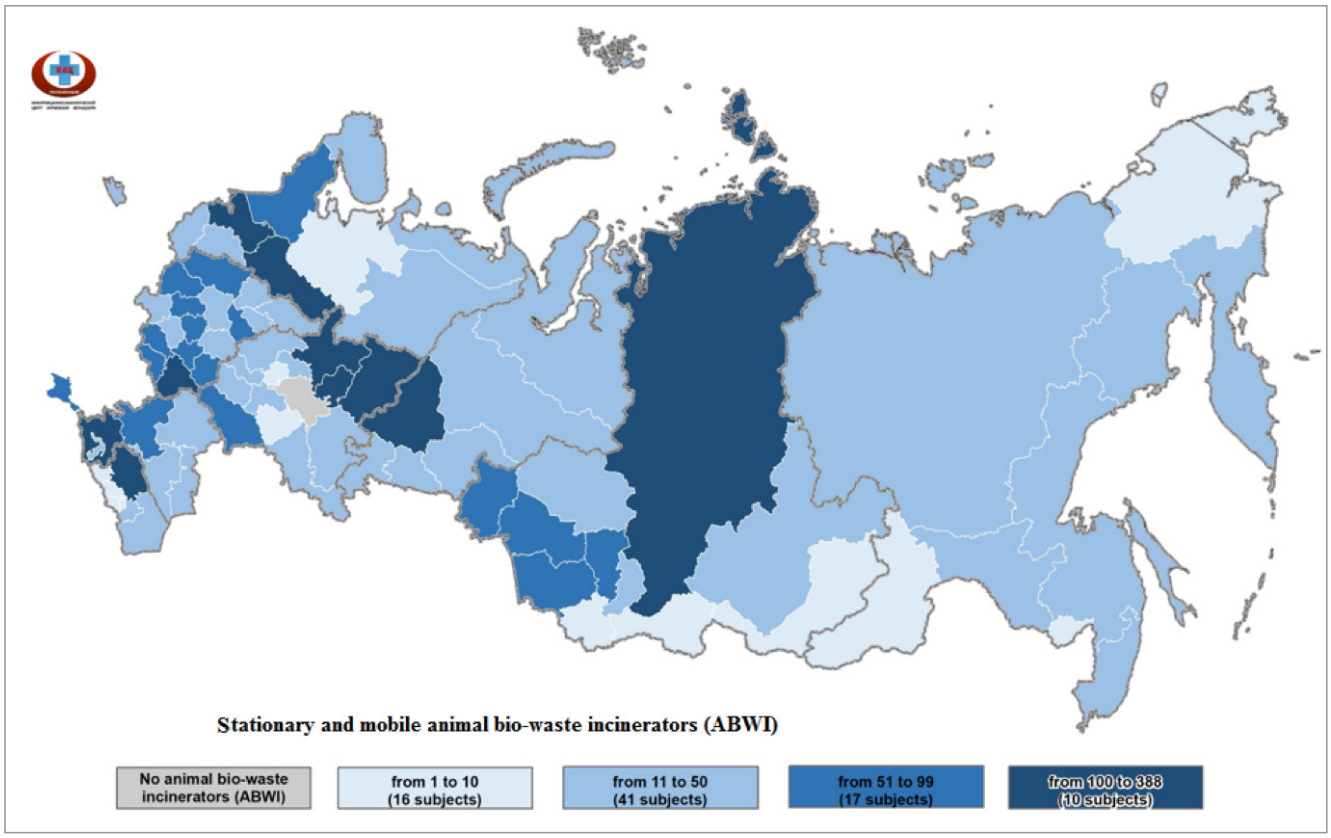

Fig. 1. Total number of animal biowaste incineration (ABWI) units registered in the Russian Federation (as of 01.01.2021)

epidemic conditions. Besides, work on such equipment requires professional training of maintenance personnel. Along with stationary units, there are mobile units that can be transported by almost any type of transport and installed on site in just a few minutes, but, as a rule, they have low productivity [12, 13].

The most common on the territory of the Russian Federation is the second method – the burning of animal biowaste in pits. The advantages of this method are obvious at first glance – relative simplicity and low costs. However, such an incineration method is ineffective, since the process of animal biowaste incineration using such a method is quite slow due to insufficient amount of oxygen in the burning area [14, 15]. The method of animal biowaste burning in pits should be gradually replaced by more contemporary methods, but actually it is still used in the countries with the high technological expertise.

In this regard the purpose of the research was to review the situation of ensuring biological safety in the country during animal biowaste incineration using especially designated units.

MATERIALS AND METHODS

In order to conduct the study, the specialists of the FGBI "ARRIAH" developed a form for collecting primary data, including such indicators as the number, type (stationary, mobile), ownership, location, availability of a certificate, and qualified specialists servicing animal biowaste incinerators, as well as the demand of Subjects for these units. Data for the period from 01.01.2020 to 01.01.2021 were collected using the Assol.Express operational reporting system. The primary data collected for 85 Subjects of the Russian Federation were analyzed.

The study used generally accepted methods of data analysis: generalization and formalization of information, the method of comparative analysis, methods of descriptive statistics.

In order to visualize the obtained data by mapping, the geographic information system ArcGIS 10.6 was used.

RESULTS AND DISCUSSION

General parameters. As of 01.01.2021, 4,459 animal biowaste incinerators are registered in the RF Subjects. They are located in all RF Subjects with the exception of the Republic of Tatarstan.

The total number of incinerators in the Russian Federation falls in the range of 2 to 388 units and most of them (45%) are located in 10 Subjects of the country. At the same time in 16 Subjects this parameter does not exceed 10 units, and in 41 Subjects of the country the total number of biological waste incineration facilities is in the range of 11 to 50 units (Fig. 1).

The results of the data analysis for the type of ownership revealed that 78% of the units are owned by or are on the balance sheet of organizations of various forms of ownership (SPK, OAO, ZAO, IP, etc.), whose activities are maintenance/rearing of farm animals, as well as processing, production and storage of livestock products. The smallest part of them falls on the municipalities of the RF Subjects (7.8%) (Fig. 2).

In the RF Subjects, the largest part (95%) of these units are stationary. The number of mobile incinerators

in the country is 231 units, which are registered in 44 Subjects. In most of them, the number of mobile biological waste incinerators is in the range from 1 to 7 units, while about half are concentrated in 5 Subjects.

In recent years, there has been a trend in the Russian Federation to reduce the number of animal burial grounds and biothermal pits. First of all, this is due to the introduction in 2006 of a ban on the destruction of biological waste by burial and the presence of a significant number of animal burial grounds not owned or managed by legal entities that would be responsible for their maintenance, preservation and use [3]. As a result, in some RF Subjects, targeted programs have been developed and put into effect. They are aimed at the elimination of unused and ownerless cattle burial grounds. The purpose of these programs is to prevent unauthorized burial of biological waste and the spread of pathogens of human and animal infectious diseases in the environment, as well as to reduce regional budget expenditures for their maintenance and ensuring their compliance with veterinary and sanitary requirements.

Thus, the municipalities of the RF Subjects, subordinate institutions of the State Veterinary Service of the RF Subjects, as well as livestock breeding and processing establishments are gradually moving from burial in animal burial grounds to disposal using animal biowaste incinerators (cremators, industrial and home-made incinerators). In the reporting period, the above institutions purchased and put into operation 266 incinerators, and 82% of them are organizations whose activities are related to keeping, raising farm animals, as well as processing, producing and storing livestock products.

Despite the fact that for the period from 01.01.2020 to 01.01.2021 the number of animal biowaste incinerators increased by 10%, in 44 Subjects of the Russian Federation, Subjects there is an additional demand for 2,129 incinerators. In some regions the number of units varies from 1 to 728 units, for 41% of the Subjects the demand for incinerators does not exceed 10 units.

Requirements for the animal biowaste incineration process in cremating furnaces. The disposal and destruction of biological waste of animal origin is regulated by the "Veterinary rules for movement, storage, rendering and disposal of biological waste", approved by the Order of the Ministry of Agriculture of Russia dated October 26, 2020 No. 626 [1].

These rules establish mandatory veterinary and sanitary requirements for the handling of biological waste of animal origin (collection, transportation, storage, disposal, destruction) both for animal owners, regardless of the method of farming, and for organizations and establishments of all forms of ownership.

However, in the veterinary legislation of the Russian Federation there is no any legal act regulating the procedure for animal biowaste incineration in home-made incinerators. There are no mandatory requirements for the technical characteristics of biological waste incinerators (mandatory certification, productive capacity, chamber volume, wall thickness, etc.), for their location (technical requirements for the room where these units are located and the enclosure), and for the incineration process itself (requirements for service personnel, disinfection of tools, transport and overalls, the method of destruction of the resulting combustion products, etc.) (Fig. 3).

The fact that this biowaste destruction method is not regulated, makes it difficult for the veterinary regulatory authorities to fully implement control and supervision measures for compliance with the veterinary and sanitary requirements for animal biowaste incinerators.

According to veterinary legislation, a veterinary specialist, after examining biological wastes of animal origin,

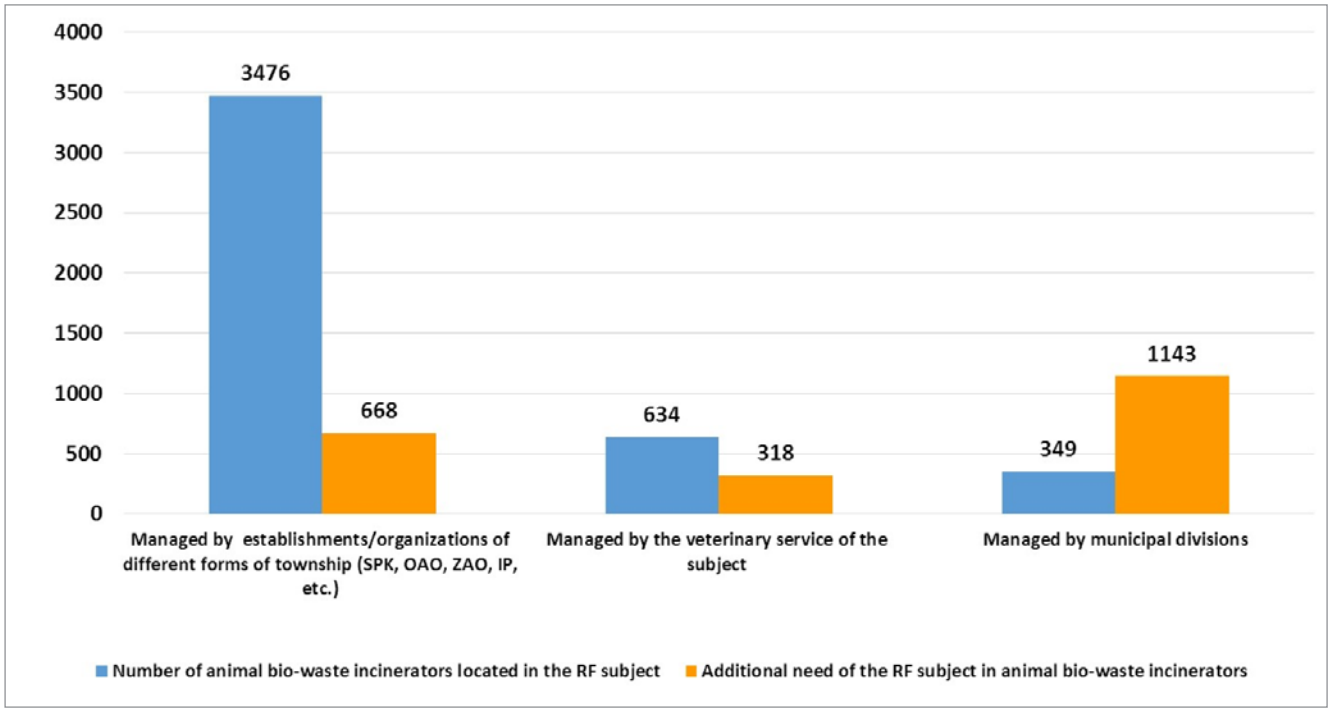

Fig. 2. Animal biowaste incinerator availability and demand in the country

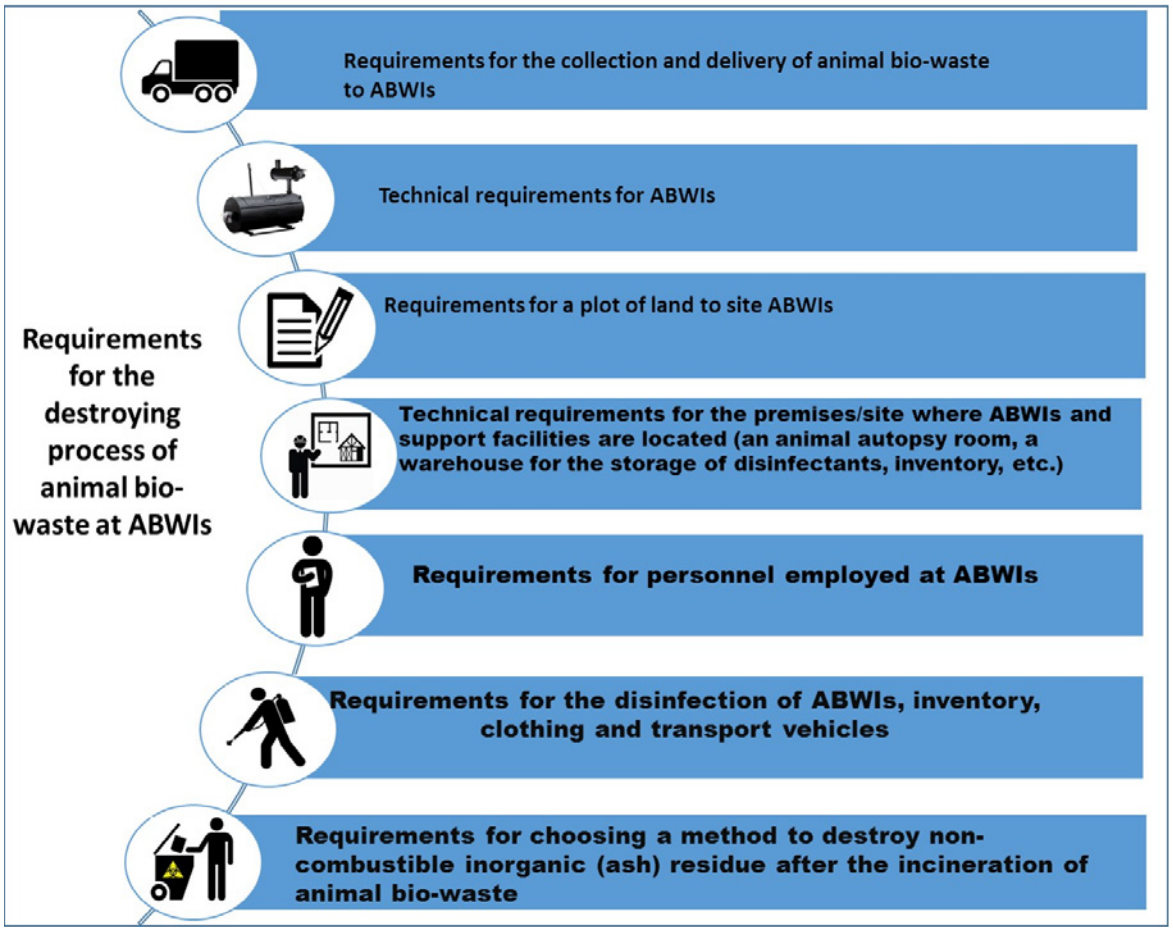

Fig. 3. Animal biowaste incineration procedure in home made incinerators, cremating furnaces and incinerators and its control

gives an opinion on their cleaning and decontamination method, and also prepares a veterinary accompanying document. Delivery of the biowastes to the place of destruction is provided by their owners. Biological wastes are placed in special closed containers and delivered by special transport means. Dead animals more 25 kg each, except for those contaminated with agents of anthrax, rinderpest, can be transported without biohazardous waste containers in vehicles covered with tilts or other devices preventing the dead animals from falling out and contamination of the environment [1]. This transport can belong to the owners of biowastes and organizations providing services for the destruction or disposal of biological waste of animal origin. At the same time, it should be noted that the containers and vehicles used for transportation of biological waste of animal origin are not subject to mandatory certification.

Since incinerators are high risk facilities, it is expedient to confirm that their quality complies with requirements for veterinary, sanitary, environmental and fire safety.

Currently, according to the Russian legislation, mandatory certification of biowaste incinerators is provided only for fire safety. Moreover, the certificate of conformity confirms the quality of not the entire unit, but only its component, in particular the burner used in it (gas, liquid fuel) [16]. The environmental certificate of compliance with environmental safety standards for manufacturers of biowaste incinerators is issued on a voluntary basis [17].

As for the certification of the animal biowaste incinerator conformity with requirements for veterinary and sanitary safety, this procedure is not provided for by the legislation of the Russian Federation. In this regard, it is not possible to determine the adequacy of the choice and observance of temperature and time modes for the destruction of various categories and types of biological waste of animal origin. Although these specific characteristics are the determining factor in the ability of biowaste incinerators to provide complete inactivation of animal pathogens.

Based on the practical experience of specialists who participated in the eradication of the infectious animal disease outbreak, it can be noted that the carcasses of various animal species burn for different periods of time and at certain temperatures. For example, turkey carcasses do not burn well enough compared to pig carcasses, which is due to the difference in the chemical composition and density of their muscle mass.

In the reporting period, 28% of the animal biowaste incinerators in the country do not even have fire safety and environment safety certificates of conformity. Thus, it can be assumed with a high degree of certainty that these units were not manufactured industrially, but are man made that is, any means at hand could be used for their construction: barrels, gas cylinders, welded boilers, etc.

The use of such units during biological waste burning cannot ensure the complete inactivation of infectious animal disease pathogens and, therefore, the proper level of biological protection of animals and humans from these pathogens.

According to article 7.1.12 SanPiN 2.2.1/2.1.1.1200-03 "On sanitary protection zones and sanitary classification of establishments, buildings and other facilities"[1], incinerators belong to Hazard Class I. In order to ensure the sanitary and epidemiological well-being of the population, a 1000 m buffer area should be established around biowaste incinerating facilities (sanitary protection zone). However, in 36 Subjects of the Russian Federation, incinerators (502 units) are located within the residential area. The bulk of these facilities are concentrated in the Central (37%) and Siberian (31%) Federal Districts.

It should be noted that compliance with this requirement is impracticable for the owners of mobile animal biowaste incinerators since the placement of these units on the territory of the settlement for destruction of biological waste is not regulated.

An essential condition for ensuring biological safety during the biowaste incineration is the correct arrangement of a room or building where animal biowaste incinerators and auxiliary premises are located: an autopsy room, a warehouse for storing disinfectants, tools, etc. At the moment, the RF legislation has no regulated norms and rules for these premises.

The incineration of biological wastes and the maintenance of the facility requires qualified personnel. It is necessary to allow persons who have been trained and tested on the technical characteristics, principles of operation and maintenance of incinerators to work with these units. In addition, the personnel must have a permit for the right to handle hazardous waste and be immunized in accordance with the national vaccination schedule.

During the research, it was found that 46% of the animal biowaste incinerators are served by personnel who have not undergone appropriate training. The lack of necessary knowledge regarding the technical characteristics of the units, as well as the process of incineration, disinfection, etc., can contribute to the spread of pathogens of infectious animal diseases into the environment.

Disinfection is critical when it comes to the system of veterinary and sanitary measures ensuring infectious animal disease freedom in the Russian Federation. Its main purpose is the destruction or neutralization of infectious animal disease pathogens (birds, fish, bees) in the environment [18].

In this regard, biowaste incinerators, tools, overalls, and vehicles used for transportation and burning of biological waste of animal origin shall be treated with disinfectants. Disinfection must be performed by trained specialists under the supervision of the State Veterinary Service. Employees responsible for disinfection also carry out sampling to control the quality of disinfection and maintain documentation (disinfection reports, disinfectant receipt, consumption logs, and a disinfection log). Disinfection quality control shall be performed after each biowaste incineration process.

Despite a significant decrease in the volume (up to 95%) of animal biological waste after incineration, combustion products (ash and other non-combustible residues) remain in incinerators, the destruction of which is carried out by various acceptable methods. During the reporting period the resulting combustion products after animal biowaste burning in most cases (63%) were taken to municipal solid waste landfills or dumped into biothermal pits, in 17% of cases they were buried at cattle burial grounds, and in 20% cases (in 31 RF Subjects) they were used as a fertilizer, which is a violation of Russian legislation, since this ash residue is not included in the list of certified fertilizers in the Russian Federation.

As noted earlier, almost a third of the available units in the country are home made, i.e. the use of these incinerators does not guarantee the complete combustion of biological waste of animal origin and the inactivation of pathogens. Consequently, the removal of residue combustion products to municipal solid waste landfills contributes to the contamination of territories with pathogens of infectious animal diseases.

CONCLUSION

The results of the analytical study performed show that as of January 1, 2021, there are a number of gaps in the field of animal biological waste incineration due to both the imperfect regulatory framework and the shortcomings in the organization of this system in the RF Subjects.

First of all, this is due to the fact that at the legislative level there are no rules regulating the procedure for animal biowaste incineration in home made incinerators. At the same time, the situation is aggravated by the fact that these hand made incinerators are used in a significant number of the RF Subjects, they have no certificates of conformity in the field of fire and environmental safety. About half of the incinerators are operated by unqualified personnel who are not aware of the technical characteristics and principles of operation of these units.

The current situation in the country in the field of ensuring biological safety during animal biowaste incineration using home made incinerators demonstrates the need to introduce the following corrective measures: fix the requirements for the technical characteristics of incinerators and the process of animal biowaste destruction at the legislative level; develop and adopt a legal act regulating the activities of mobile units for the thermal treatment of biological waste; develop unified forms for biowaste incinerator recording; prepare unified checklists for scheduled and unscheduled inspections of animal biowaste incinerating facilities performed by veterinary services; introduce mandatory certification of biological waste incinerators for their compliance with established veterinary and sanitary safety requirements.

It is also necessary to make additions to the existing "Cerberus" IS components of the "VetIS" information platform, which will allow the creation of the federal register of animal biowaste incinerators, whose veterinary and sanitary safety has been confirmed. This will allow the "Mercury" IS to block registration of veterinary accompanying documents for the movement of biological waste to disposal and destruction facilities not specified in this register.

[1] SanPiN 2.2.1/2.1.1.1200-03 "On sanitary protection zones and sanitary classification of establishments, buildings and other facilities": approved Decree of the Chief State Sanitary Doctor of the Russian Federation 25.09.2007 No. 74. Available at: https://base.garant.ru/12158477/b89690251be5277812a78962f6302560.

The implementation of the above measures will improve control over the safety of animal biowaste incineration in facilities intended for this particular purpose.

REFERENCES

1. Veterinarnye pravila peremeshcheniya, khraneniya, pererabotki i utilizatsii biologicheskikh otkhodov = Veterinary rules for movement, storage, rendering and disposal of biological wastes; approved by the Russian MoA Order No. 626 as of October 26, 2020. Available at: https://docs.cntd.ru/document/566144088. (in Russ.)

2. GOST 30772-2001 Resources saving. Waste treatment. Terms and definitions. Moscow: Standartinform; 2008. 16 p. Available at: https://docs.cntd.ru/document/1200028831. (in Russ.)

3. Belchikhina A. V., Shibaev M. A., Klinovitskaya I. M., Karaulov A. K. The state of animal waste rendering and disposing system in the subjects of the Russian Federation. *Veterinary Science Today*. 2019; (4): 54–60. DOI: 10.29326/2304-196X-2019-4-31-54-60.

4. Federal Service for Veterinary and Phytosanitary Surveillance (Rosselkhoznadzor). Ob oformlenii veterinarnykh soprovoditel'nykh dokumentov na biologicheskie otkhody = On issuance of veterinary accompanying documents for biological wastes. Available at: https://fsvps.gov.ru/fsvps/news/39214.html. (in Russ.)

5. Zakon RF «O veterinarii» = RF Veterinary Law, May 14, 1993 No. 4979-1 (as amended on 02.07.2021). *ConsultantPlus*. Available at: http://www.consultant.ru/document/cons_doc_LAW_4438. (in Russ.)

6. Federal'nyi zakon «O sanitarno-epidemiologicheskom blagopoluchii naseleniya» = Federal Law "On sanitary and epidemiological safety of the population" No. 52-FZ as of March 30, 1999 (as amended on 03.08.2018). *ConsultantPlus*. Available at: http://www.consultant.ru/document/cons_doc_LAW_22481. (in Russ.)

7. Bondareva E. D. Proper waste management. Vivarium biological waste. *Laboratory Animals for Science*. 2020; (1): 3–8. DOI: 10.29296/2618723X-2020-01-01. (in Russ.)

8. Zroichikov N. A., Fadeev S. A., Khaskhachikh V. V., Biryukov Ya. A. Analiz putei ekologicheski bezopasnogo obezvrezhivaniya meditsinskikh i biologicheskikh otkhodov = Analysis of sustainable methods for medical and biological waste decontamination. *Nauka segodnya: problemy i perspektivy razvitiya = Science today: problems and development prospects: materials of the International Scientific and Practical Conference (November 29, 2017)*. Vologda; 2017; 108–113. eLIBRARY ID: 32502937. (in Russ.)

9. Ershov A. G., Shubnikov V. L. Meditsinskie i biologicheskie otkhody: problemy i puti resheniya = Medical and biological waste: problems and solutions. *Tverdye bytovye otkhody*. 2011; 2 (56): 16–19. eLIBRARY ID: 15566020. (in Russ.)

10. Eldesbaev E. N., Petrova I. V., Kotel'nikova E. A. Analysis of modern trends handling system biowaste environmental economics. *Upravlenie ekonomicheskimi sistemami: elektronnyi nauchnyi zhurnal*. 2015; 3 (75):31. eLIBRARY ID: 23306512. (in Russ.)

11. Miller L. P., Miknis R. A., Flory G. A. Carcass management guidelines – Effective disposal of animal carcasses and contaminated materials on small to medium-sized farms. FAO Animal Production and Health Guidelines. Rome: FAO; 2020; No. 23. DOI: 10.4060/cb2464en.

12. Mkrtumyan A. V., Kudryavtsev E. A., Korzhevenko G. N. Problems on burning the biological residues and scraps in case of epizooties. *The Russian Journal "Problems of Veterinary Sanitation, Hygiene and Ecology"*. 2012; 2 (8): 57–58. eLIBRARY ID: 22911832. (in Russ.)

13. Poklonskii D. L., Matveev A. V., Chifanov D. E., Durilov O. Yu., Zygin D. A., Ermilov N. V., et al. Methodical aspects of disposal of dead animals in the elimination of the epizootic focus. *Journal of NBC Protection Corps*. 2017; 1 (4): 50–58. eLIBRARY ID: 36479177. (in Russ.)

14. Smirnov A. M., Butko M. P., Korzhevenko G. N., Kudrjavtsev E. A., Mkrtumjan A. V. Combustion of infected biological wastes including dead animal bodies. Patent No. 2540745 Russian Federation, Int. F23G 1/00 (2006.01). Gosudarstvennoe nauchnoe uchrezhdenie Vserossijskij nauchno-issledovatel'skij institute veterinarnoj sanitarii, gigieny i ehkologii Rossijskoj akademii sel'skokhozjajstvennykh nauk. No. 2013151376/03. Date of filing: 20.11.2013. Date of publication: 10.02.2015. Bull. No. 4. (in Russ.)

15. Mkrtumyan A. V., Kudryavtsev E. A. Technological aspects of burning corpses fallen and slaughtered animals at epizootic. *The Russian Journal "Problems of Veterinary Sanitation, Hygiene and Ecology"*. 2015; 3 (15): 72–74. eLIBRARY ID: 24260568. (in Russ.)

16. Customs Union Technical Regulation TR CU 010/2011. "On the safety of machines and equipment": approved by the Decision of the Commission of the Customs Union dated October 18, 2011 No. 823. Available at: https://docs.cntd.ru/document/902307904. (in Russ.)

17. Ob organizatsii sistemy sertifikatsii po ekologicheskim trebovaniyam dlya preduprezhdeniya vreda okruzhayushchei prirodnoi srede (sistemy ekologicheskoi sertifikatsii) = On the organization of a certification system for environmental requirements to prevent harm to the environment (ecological certification systems): order of the Ministry of Environmental Protection and Natural Resources of the Russian Federation dated January 23, 1995 No. 18. Available at: https://docs.cntd.ru/document/9027409. (in Russ.)

18. Pravila provedeniya dezinfektsii i dezinvazii ob"ektov gosudarstvennogo veterinarnogo nadzora = Rules for disinfection and disinfestation of regulated facilities: approved Ministry of Agriculture of the Russian Federation No. 13-5-2/0525, July 15, 2002. Available at: https://docs.cntd.ru/document/1200112793. (in Russ.)

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