VOL III

Estudos em Ciências Agrárias e Ambientais

Eduardo Spers
(Organizador)

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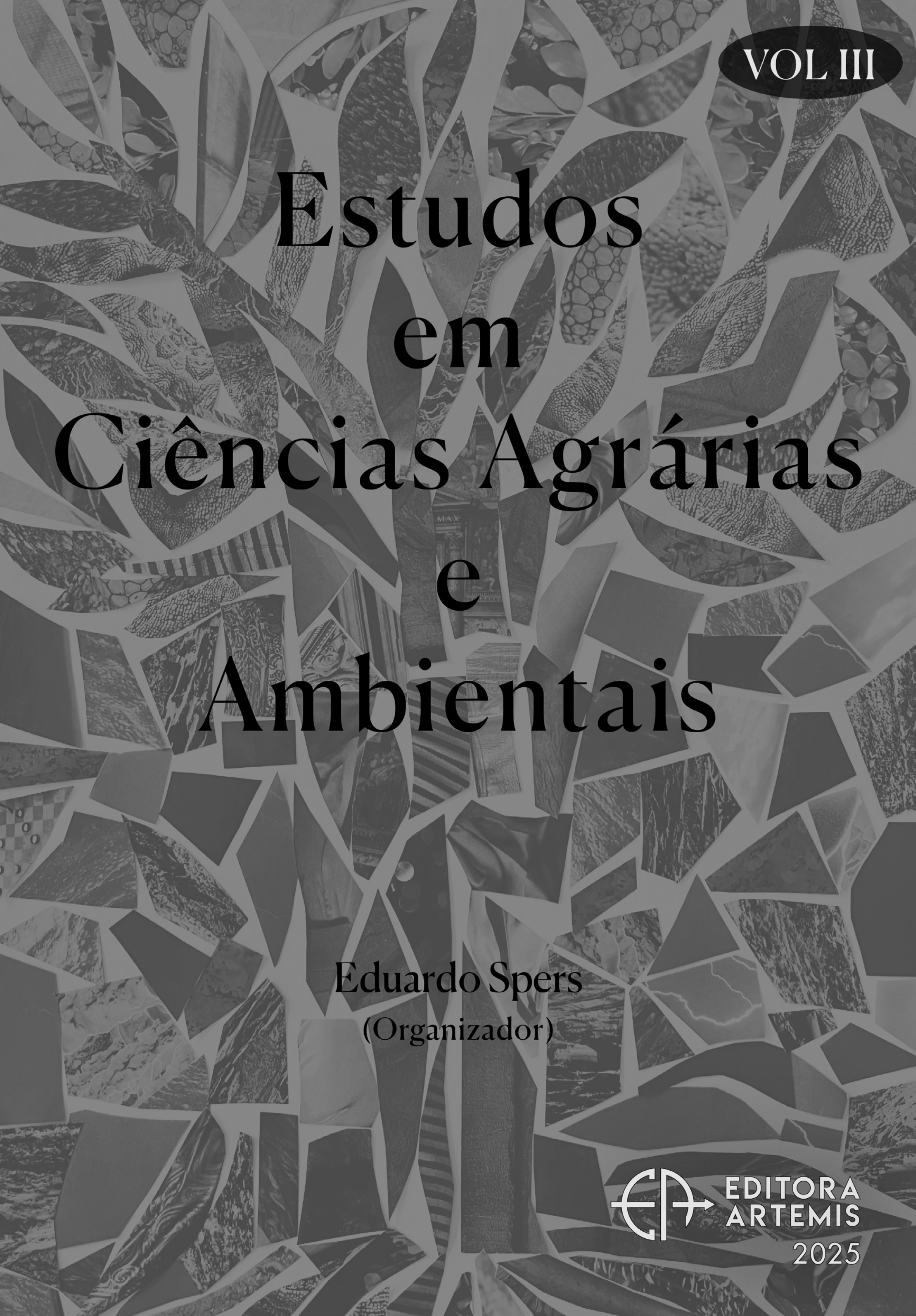
2025



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INTRODUÇÃO

O campo das Ciências Agrárias e Ambientais é vasto e dinâmico, abrangendo uma diversidade de abordagens, técnicas e inovações essenciais para o avanço da agricultura, da pecuária e do manejo dos recursos naturais. Em um mundo em constante mudança, em que a sustentabilidade e a busca por soluções eficientes para os desafios ambientais são cada vez mais urgentes, a contribuição dos profissionais das agrárias se torna fundamental para a construção de um futuro mais equilibrado e saudável.

O Volume III de **Estudos em Ciências Agrárias e Ambientais** reúne pesquisas de autores de diversas partes do mundo, contribuindo com uma série de investigações que exploram desde os fundamentos da agroecologia até as complexas interações entre os seres humanos e o meio ambiente. A primeira parte aborda questões cruciais relacionadas à sustentabilidade, desde a utilização de biopreparados como soluções ecológicas até a medição de emissões poluentes em processos produtivos, refletindo o compromisso com práticas agrícolas que buscam respeitar os ciclos naturais e minimizar impactos negativos no planeta.

Em seguida, somos conduzidos a uma viagem pelo campo da genética e do melhoramento de plantas, uma área essencial para garantir a segurança alimentar global e o uso mais eficiente dos recursos naturais. Através de uma análise detalhada, os estudos nos apresentam a diversidade genética e os avanços que permitem o desenvolvimento de culturas mais resilientes e produtivas.

O livro também nos convida a refletir sobre os diferentes aspectos do manejo de cultivos, abordando desde as propriedades físicas das madeiras tropicais até as técnicas agrícolas adaptadas a regiões semiáridas, sempre com o olhar atento para as melhores práticas agrícolas, que promovem uma integração harmoniosa entre o ser humano e a terra.

Por fim, encontramos uma seção dedicada à produção animal, que explora o papel fundamental da pecuária na alimentação e economia global, além das questões relacionadas à saúde animal. A conexão entre a produção e a saúde dos animais é uma chave para garantir a qualidade e a sustentabilidade dos sistemas produtivos, abrangendo desde práticas de manejo até o desenvolvimento de estratégias veterinárias inovadoras.

Através destes trabalhos, buscamos oferecer uma visão abrangente e integrada de diversos aspectos das ciências agrárias, com o objetivo de contribuir para o avanço do conhecimento, da pesquisa e da prática no campo. Este é um convite à reflexão sobre o papel fundamental que a ciência e a inovação desempenham na construção de um futuro agrícola mais sustentável, saudável e próspero para todos.

Desejo a todos uma proveitosa leitura!

Eduardo Eugênio Spers

SUMÁRIO

CAPÍTULO 2

EXPERIMENTAL MEASUREMENTS OF POLLUTING EMISSIONS FROM COMBINED FEED FACTORIES FOR ENVIRONMENTAL PROTECTION

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ABSTRACT: Specialists in the field know very well that an important source of food for animals raised on livestock farms is the combined feeds, because in addition to ground cereals they also contain proteins, amino acids, minerals, vitamins and sometimes even certain medicines, energizers or flavors. The process of obtaining different varieties of combined feeds involves a complex technological flow, with specific stages of production. Mixing, sterilization and granulation activities, where steam jets are used at very high temperatures determine the elimination of different types of noxious substances in the air. In this article are presented the experimental measurements performed at the critical points of working installations from a combined feed factory, on the entire duration of the assortment lot. Considering the purpose of the performed researches, the critical measurement points were established at the exit of steam generator, where steam jets are obtained at very high temperatures, with values of approximately 150-180ºC. By using a gas analyzer of the type TESTO 350 M/XL, the measured values allow a complete analysis of the types of noxious emissions. The results of experimental measurements show that the fluctuations obtained during the measurements are very small, of the order 2 mg/m^3_N for each type of noxious eliminated, which indicates a very good regulation of the work process. The average values of the eliminated noxious substances (CO, NOx, CO2) shows the full compliance with European environmental quality standards. The use of high-performance equipment and work devices, with a high degree of automation and computerization allows rigorous control over the different types of pollutants released in the atmosphere by the working installations from combined feed factories.

KEYWORDS: Combined feeds. Noxious emissions. Automation. Environment.

1 INTRODUCTION

Both the rapid demographic growth in recent decades and the diversification of human needs have led to an upward evolution of activities in the zootechnical field. Thus, the use of combined feeds for feeding animals on zootechnical farms has become very necessary, both for providing good quality nutrients and for reducing the costs of animal products. Depending on the age of the animals or the species of animals fed, certain combined feed recipes are used, with different compositions, shapes and weights of the granules (Mihaila, 2001; Gaceu, 2006; Şara et al., 2005).

In a combined feed factory, a very complex technological flow takes place, during which the cereals and mineral substances that make up the desired recipe are mixed, homogenized, granulated and sterilized using high-performance equipment and working installations. From the combustion equipment that produces the steam necessary for sterilization and homogenization in different forms of combined feed and also from the cooling facilities of the final product, various types of pollutants are released into the atmosphere (Roden et al., 2006). These emissions of polluting substances can affect the health of people working in these factories and also the environment.

This is the main reason why it is absolutely necessary to monitor and control rigorously the concentrations of pollutant substances from the gases emitted by the work installations which have combustion sources or internal combustion engines (Heinsohn and Kabel, 1999; Lailer, 2005; Franke, 2006). At critical working points, that is, at the outlet of the hot steam generator, samples were taken and various experimental measurements were made in order to analyze the functional parameters of the work installations.

The paper presents a complex methodology for measuring the concentrations of different types of pollutants resulting from the process of obtaining combined feeds. Experimental analyzes and measurements for the determination of flue gases emissions from the steam generator outlet were performed using the TESTO 350 M/XL gas analyzer over a period of 100 minutes (which represents the minimum duration for making a batch of combined feed assortment). The experimental studies carried out propose an analysis of the functional parameters of the working installations in the combined feed factory, in order to automate the control of the steam temperature and implicitly of the combustion installation (that determines the elimination of noxious substances in the air). For this purpose, separate locations for experimental measurements were used in the burner area of the steam generator.

Given that each combined feed recipe requires different operating parameters of the work facilities, samples obtained during the technical process for the production of two combined feed recipes were analyzed: for the feeding of broilers, respectively for the feeding of swine.

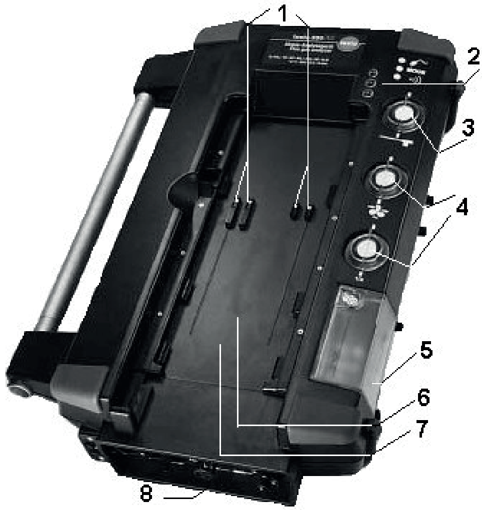
2 MATERIALS AND METHODS

One of the stages of the technological flow from a combined feed factory is that in which the necessary ingredients from the recipe are mixed, which will be performed under the action of steam jets with very high temperatures. These jets are produced by a steam generator and are needed to obtain granules of different shapes and sizes (Bond et al., 2002). Also, the steam jet at very high temperatures has other important purposes in obtaining the final product: homogenization of granules and their sterilization. An essential work equipment from the combined feed factory where the experimental measurements were performed is the steam generator (Certuss Junior), having as primary fuel the liquefied petroleum gas (LPG).

Given the purpose of the research conducted, samples were taken at the outlet of the steam generator and experimental measurements were performed in order to analyze the working parameters of the equipment and installations used (Bollen et al., 2014). Thus, at this critical working point, the pollutant emissions from the flue gases resulting from the process of obtaining the steam jet were measured. During researches on flue gas, the TESTO 350 M/XL gas analyzer was used, in order to obtain the measured values for the noxious substances released at the outlet of the steam generator. This device operates according to the following principle: the change of the current intensity generated by a galvanic cell whose electrolyte changes its properties is analyzed (due to interaction with the gaseous component removed in the air to be detected and whose concentration is to be measured). Thus, the cells used to perform the measurements are in fact galvanic elements, which generate a current proportional to the number of ions that dissociate in the electrolyte solution (as a result of the reaction obtained between the electrolyte and the noxious substance analyzed at that time). Analyzers built according to this principle have a great advantage represented by a low construction cost and are used for short or medium duration measurements. With their help, concentrations can be determined for the following gases: O_2, CO, H_2S, NO, NO_2, SO_2, etc.

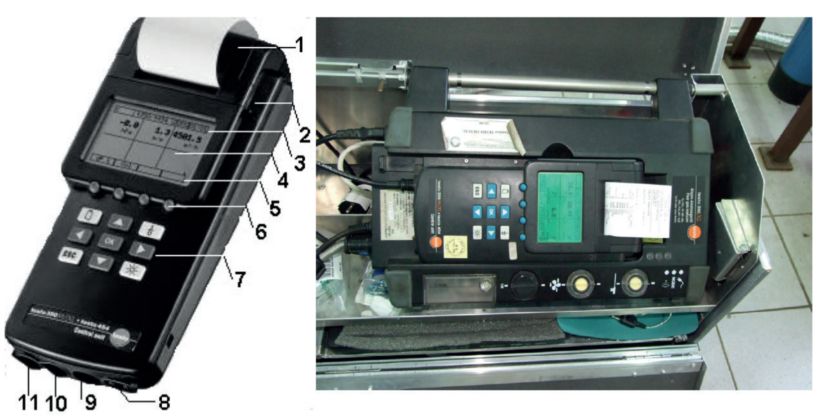
The gas analyzer of the type TESTO 350 M/XL is an advanced equipment for determining the noxious substances eliminated by the flue gases, their determination being made in specialized measuring cells (in which Peltier type electrochemical reactions take place). The device used to perform analyzes in the combined feed factory where the research took place, consists of three working components: the analysis unit, the control unit and the gas sampling probe. The effective interaction between the electrolyte and the flue gases takes place in the unit of analysis, because this is where the reaction cells are located (figure 1). Also here are the supply batteries of the device, the filters for retaining solid impurities from the flue gases, the condenser decanter and the electro-pneumatic connections with the other components.

Figure 1. The analysis unit: 1 - electrical contacts; 2 - control LEDs; 3 - solid particle filter; 4 - filters for retaining particles from the aspirated air; 5 - condensate collection; 6 - analysis cells; 7 - integrated system for determining the gas velocity and pressure; 8 - connections.



Due to the Peltier type electrochemical reactions that take place inside the analysis unit, an electrical signal is emitted to the control unit of the device, thus displaying the concentration value corresponding to the type of noxious substance analyzed (Ionel, 1994). The TESTO 350 M/XL analyzer has a control unit (figure 2), which is a device that can be operated with the help of the built-in keyboard, or with a special contact pencil (touch-pen).

Figure 2. Control unit: 1 - printer; 2 - touch-pen; 3 - system information bar; 4 - display of measured values; 5 - bar for operation information; 6 - function operation keys; 7 - keyboard; 8 - pressure probe connection; 9 - sample connection; 10 - analysis unit connection; 11 - serial interface.



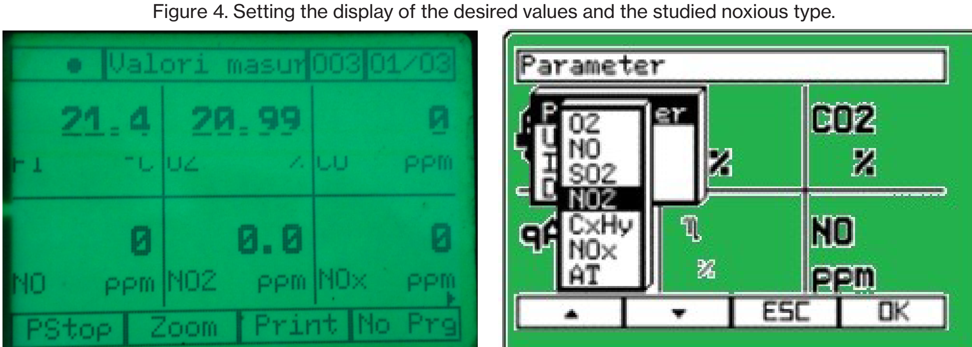
The analyzer can be equipped with several types of gas sampling probes, depending on the characteristics of the sampled gases. To performing the experimental measurements was used a probe with tubing heated at 180°C, operating at temperatures up to 1200°C.

After the three components are interconnected, the analyzer will be switched on by connecting to the 220V mains or using its own batteries. At this point the device enters automatically in the procedure of "zero calibration" and washing of the reaction cells (figure 3). At the time of "zero calibration", the probe of the device must not be inserted into the flue.

Figure 3. Zero calibration procedure of the Testo 350 M/XL analyzer.

After the analyzer enters in normal operation regimen, it must be programmed to acquire and display the data of interest for the analysis performed (Vasile, 2018). Also now is made the setting for the studied noxious type, from the device database (figure 4).

Figure 4. Setting the display of the desired values and the studied noxious type.



After setting the parameters we want to measure, the probe is inserted into the gas channel and the activity of measuring the monitored parameters is started (Vasile, 2018). The values obtained from the analysis and measurements carried out will be compared with the limit values provided in the legislation in force (in order to confirm compliance with the rules imposed by the European Union). The measurements of the noxious concentrations eliminated by the flue gases from the steam generator were performed during the combined fodder production processes for two species of animals, with a large share in the livestock farms: broilers and swine. During 100 minutes (in which an assortment of combined fodder is produced), ten distinct measurements were performed for the noxious substances eliminated in the air (at an interval of 10 minutes between them).

If the TESTO 350 M/XL analyzer will be connected to a computer, it can be used for long term measurements (days, weeks) by running a special program: TESTO Easy Emissions.

3 RESULTS AND DISCUSSION

The thermodynamic parameters of the steam generator in the case of the production of combined feeds for broilers are: steam temperature in the installation 140°C; thermal agent temperature 170°C; nominal steam pressure 6 bar. The results of the measurements for the released emissions are presented in table 1.

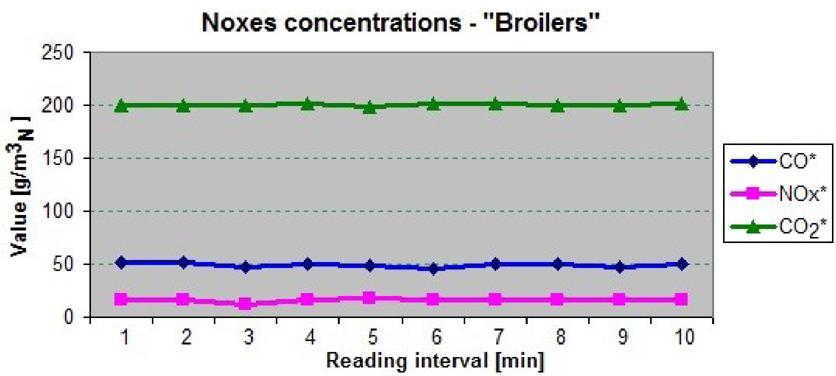
Table 1. Measurement values during combined feed production for broilers.

No.	CO [mg/m^3_N]	NOx [mg/m^3_N]	SO2 [mg/m^3_N]	CO2 [g/m^3_N]	CO* [mg/m^3_N]	NOx* [mg/m^3_N]	SO2* [mg/m^3_N]	CO2* [g/m^3_N]
1	46.25	14.37	0.00	182.44	50.79	15.78	0.00	200.36
2	46.25	14.37	0.00	182.44	50.79	15.78	0.00	200.36
3	42.50	10.26	0.00	182.44	46.67	11.27	0.00	200.36
4	45.00	14.37	0.00	182.63	49.69	15.87	0.00	201.68
5	45.00	16.42	0.00	182.63	49.09	17.91	0.00	199.24
6	41.25	14.37	0.00	182.63	45.55	15.87	0.00	201.68
7	45.00	14.37	0.00	182.63	49.69	15.87	0.00	201.68
8	45.00	14.37	0.00	182.44	49.42	15.78	0.00	200.36
9	42.50	14.37	0.00	182.44	46.67	15.78	0.00	200.36
10	45.00	14.37	0.00	182.63	49.69	15.87	0.00	201.68
Average	44.38	14.16	0.00	182.54	48.81	15.58	0.00	200.78

*) values relative to the reference oxygen 3%.

The results of the experimental measurements of the noxious concentrations eliminated in the production of combined feed for broilers are presented in graphical form in figure 5.

Figure 5. Concentrations of emitted pollutants in the case of combined feed for broilers.



The thermodynamic parameters of the steam generator in the case of the production of combined feed for swine are: the steam temperature in the installation 155°C; thermal agent temperature 180°C; nominal steam pressure 7.5 bar. The results of the measurements for the released emissions are presented in table 2.

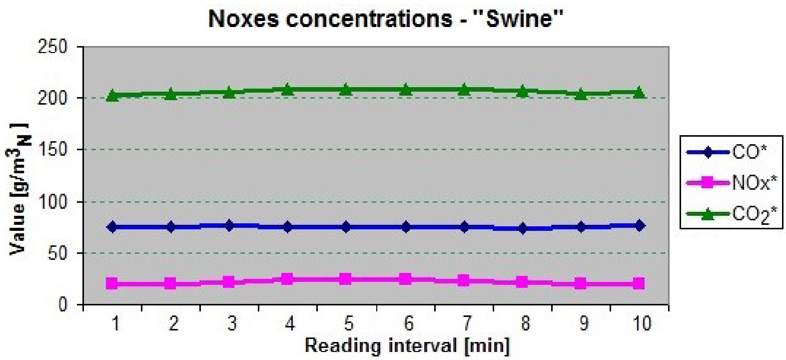
Table 2. Measurement values during combined feed production for swine.

No.	CO [mg/m^3_N]	NOx [mg/m^3_N]	SO2 [mg/m^3_N]	CO2 [g/m^3_N]	CO* mg/m^3_N]	NOx* [mg/m^3_N]	SO2* [mg/m^3_N]	CO2* [g/m^3_N]
1	63.20	17.33	0.00	170.20	75.61	20.34	0.00	203.74
2	63.24	17.35	0.00	170.35	75.61	20.57	0.00	203.96
3	63.25	17.41	0.00	171.08	76.60	20.70	0.00	206.28
4	61.85	19.37	0.00	171.31	75.10	23.56	0.00	208.62
5	61.93	19.24	0.00	172.15	75.25	23.73	0.00	208.40
6	61.95	19.42	0.00	172.40	75.30	23.80	0.00	208.54
7	62.15	19.46	0.00	172.69	75.10	23.17	0.00	208.79
8	61.82	17.30	0.00	172.82	74.18	20.61	0.00	206.85
9	63.20	17.18	0.00	170.95	75.61	20.48	0.00	204.12
10	63.30	17.36	0.00	171.26	76.05	20.55	0.00	205.98
Average	62.59	18.14	0.00	171.52	75.44	21.75	0.00	206.53

*) values relative to the reference oxygen 3%.

The results of the experimental measurements of the noxious concentrations eliminated in the production of combined feed for pigs are presented in graphical form in figure 6.

Figure 6. Concentrations of emitted pollutants in the case of combined feed for swine.



The measured values of the noxious substances from the flue gases for the two varieties of feed combined indicates very small fluctuations of the order 2 mg/m^3_N for CO, NO_x, CO_2 and also that SO2 is not eliminated in the air as an exhaust pollutant.

4 CONCLUSIONS

In order to increase the labor productivity in the combined feed factories, the aim is to increase the degree of automation of the activities in the technological flow, so as to ensure a fast and accurate measurement of the working parameters, required in obtaining the desired combined feed recipe. Meeting the requirements for pollution standards accepted in the European Union requires the use of high-performance work facilities, with a high degree of mechanization, automation and computerization.

Analyzing the measured values of the noxious substances from the flue gases for the two varieties of feed combined, it can be observed that the fluctuations obtained during the measurements are very small, of the order of 2 mg/m^3_N, for each type of noxious eliminated; this indicates a very good regulation of the work process. Another major advantage of the analyzed work installation is that SO_2 is not eliminated in the air as an exhaust pollutant; this consequence is associated with the burning of LPG in the steam generator.

As can be seen from the experimental research carried out, these automated equipments allow the rapid and permanent control of the temperatures of the steam jets, so that the noxious substances eliminated fall within the accepted limits.

The analyzes and experimental measurements performed at the output of the steam generator allowed the automated monitoring of the working parameters of the installation, in order to optimize the production process of different types of combined feeds. Also, the measured values for the concentrations of the pollutants eliminated in the air by the steam generator burner were within the provided technical limits, fully complying with European environmental protection rules.

REFERENCES

Bollen J., Brink C. (2014). Air pollution policy in Europe: Quantifying the interaction with greenhouse gases and climate change policies. Energy Econ., pp. 202–215.

Bond T.C., Covert D.S., Kramlich J.C., Larson T.V., Charlson R.J. (2002). Primary particle emissions from residential coal burning: Optical properties and size distributions, Journal of Geophysical Research: Atmospheres, vol. 107, no. D21, pp 1-14.

Franke M., Rey A. (2006). Improving pellet quality and efficiency, Buhler AG Uzwil, Switzerland, Feed Technology, vol. 1, issue 3, pp. 5-9.

Gaceu L. (2006). Modern techniques for drying cereals and technical plants, "Transilvania" Publishing House of University of Brasov, Romania, pp. 68-71.

Heinsohn R.J., Kabel R.L. (1999). Sources and Control of Air Pollution, Prentice Hall, Upper Saddle River, NJ, 696 pp.

Ionel I. (1994). Measuring emissions from flue gases using electrolytic sensors, The National Conference of Thermodynamics, Romania, vol. I, pp. 231-235.

Lailer P.C., Dahiya S.S., Lal D., Chauhan T.R. (2005). Complete feed for livestock concept, present status and future trend, The Indian journal of animal sciences, vol. 75, pp. 84–91.

Mihaila C. (2001). Industrial drying processes and installations, Technical Publishing House, Romania, pp 59-61.

Roden C. A., Bond T. C., Conway S., Pinel A. B., MacCarty N., Still D. (2006). Laboratory and field investigations of particulate and carbon monoxide emissions from traditional and improved cookstoves, Environmental Science and Technology, Vol. 40/21, pp 6750–6757.

Şara A., Odagiu A. (2005). Fodder quality control. AcademicPres Publishing House, Romania, pp. 52-58.

Vasile C. (2018). Studies about the automated control of steam temperature in the forming mold of the combined feed granules in view of environmental protection, Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, Vol. 48/2, pp. 425-430.

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