EXPERIMENTAL RESEARCH REGARDING THE NOXES ELIMINATED IN THE PRODUCTION PROCESS OF DIFFERENT ASSORTMENTS OF COMPOUND FEED FOR BROILER CHICKENS

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ABSTRACT

The production of different types of compound feed involves a complex technological flow, with operations during which are used steam jets at high temperatures which cause the elimination in the air of some noxes that must be permanently controlled.

In this article is done a theoretical analysis of the methods of measuring the different species of noxes which are released in the atmosphere during the production of compound feeds and it is studied ways of implementation an automated system for measuring the emissions of noxes resulting during these technological processes. Given that the need to protect the environment is an essential condition in approving the functioning of the compound feed factories, the objective of this article is to present some of the results of the experimental measurements regarding the emissions eliminated in the air during the technological flow.

INTRODUCTION

The technological flow from an integrated system for the production of compound feeds is realized in accordance with the methodology established by the specialists from the respective factory, as well as by the quantities of raw materials needed to make the desired recipes.

In the profile market there are produced several recipes of compound feeds, each recipe having some compositions and nutritional qualities. This is due because for each animal species, but also for different stages of evolution of animals from the same species, certain types of compound feed are used as food.

The production of compound feeds is a complex process, starting with the reception of the raw materials and their storage in special bunkers from where they are moved by the help of conveyor belts to the different work installations. Here take place other stages of the technological process (milling, granulation, sterilization, homogenization and cooling), during which steam jets are used at a very high temperature, different particles are detached and various noxes are released into the atmosphere.

The production process from the compound feed factories must be controlled at each stage of the technological flow, to ensure both the quality of the final product to be sent to the beneficiaries and the protection of the environment according to the norms and standards imposed by European Union, by ensuring a rigorous control on the different types of noxes released into the atmosphere by the working installations.

From the samples analyzed on the trail of the technological flow of compound feed production it can be analyzed the reliability of the work equipments used. Thus, through the use of high-performance working installations, with a high degree of mechanization, automation and computerization, as well as by by equipping with high-performance filters, is aimed to reduce it to the maximum the negative effects generated by the release of these pollutant emissions for protection the environment according to the imposed norms by European Union.

MATERIAL AND METHOD

During the production process of compound feeds several activities are carried out, each of them having its own specificity and significance for the technological flow (figure 1).

The product resulting from the mills, called grist, is dosed and mixed in special mixers with protein flour and mineral salts in proportions established by the manufacturing recipe. The mixture obtained is then homogenized by the help of steam jets at very high temperatures in order it can be transferred then to the granulator.

The steam generator is another a very important component in the composition of the working installation of a compound feed factory (CFF), because the steam jet with high temperatures, with values between 150-180°C, is used in the operations of homogenization and sterilization of granules with different shapes. As a result of this process, the temperature in the working area it grows a lot and also particles with small size or different types of gases are removed in the air.

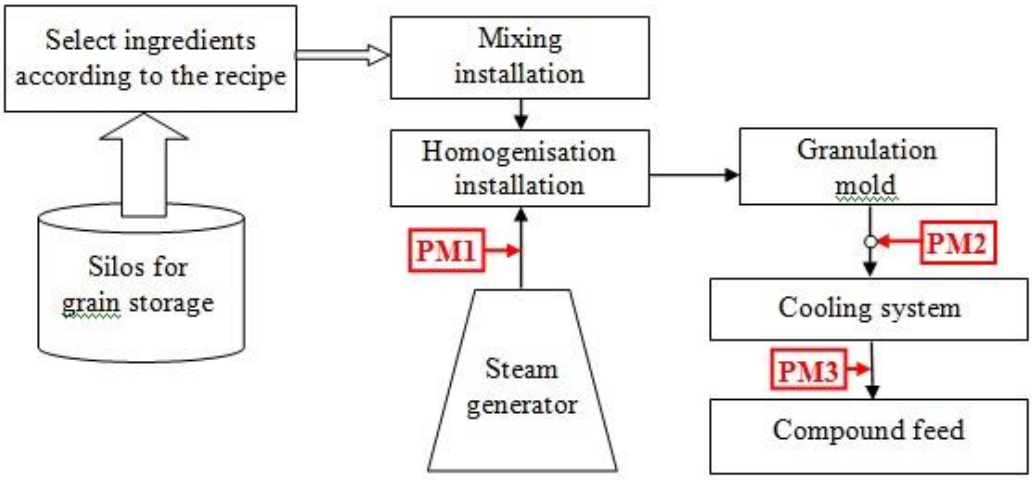

Figure 1 - The technological flow of compound feed production and the experimental measuring points of the different types of noxes eliminated in the air

In figure 1 is shows the activities that are carried out along the path of the technological flow of compound feed production and is marked the points where observations and experimental measurements were made to determine the types and quantities of noxes eliminated in the atmosphere by the working installations of compound feed factory that has been analyzed by using the National Instruments data acquisition system:

- at the exit of the steam generator to the special containers in which it is made the homogenization of the mixture of ground raw materials, protein flour and mineral salts according to the followed recipe, it was established the first point of the experimental measurement (PM 1)
- at the exit of the granulating installation where the mass of the previously homogenized mixture passes through the holes of a mold for obtaining granules of different shapes and sizes which are in turn homogenized and sterilized by means of steam jets with very high temperatures it was established the second point of measurements (PM2)
- at the exit of the cooling system of granules using some air jets at room temperature it was established the third point of the experimental measurements (PM 3).

For performing experimental measurements it has been used the TESTO 350 M/XL gas analyzer (figure 2), using a device that has been calibrated by INM.

Figure 2 – The gas analyzer of type TESTO 350 M / XL

The equipment TESTO 350 M/XL is formed of three main parts: the unit of analysis (figure 3a), the unit of control (figure 3b) and the gase sampling probe.

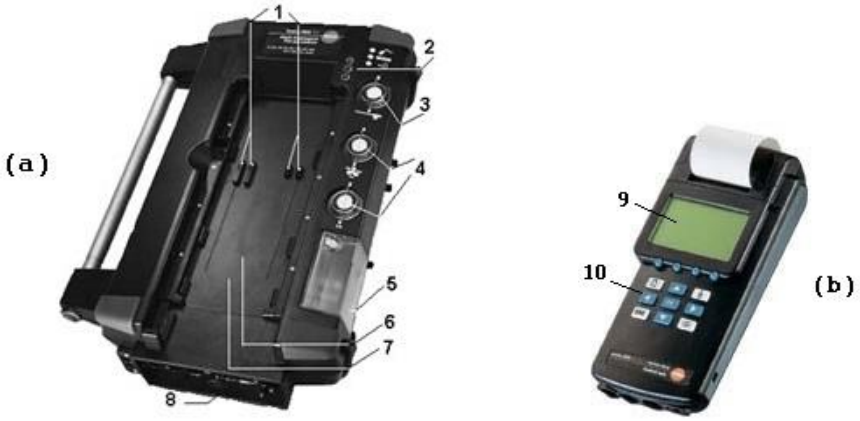

Figure 3 - The analysis unit (a) and the control unit (b)
1 - electrical contacts; 2 – LED control lights; 3 – solid particle filter; 4 - filters of particles retention from suction air; 5 – condensate collection; 6 – analysis cells; 7 – integrated system for the calculation of speed and pressure of gas; 8 – connectors; 9 – desktop; 10 – keyboard

The principle of analysis is based on the change of the intensity of the galvanic current generated by a galvanic cell whose electrolyte change their properties, following its reaction with the gaseous component eliminated in the atmosphere, whose concentration must be measured.[...]

The measuring cells used by the TESTO equipment are galvanic elements, which generate a current directly proportional to the ionic number which dissociate in the electrolyte solution, as a result of the interaction with the analysed gas at that moment.

In order to report the measured values to the legislation in force, the concentrations of the noxes must be converted from [ppm] to [mg / m3N] , with relations of the following form:

$$C_{noxa}[mg/m^3{}_N] = \frac{M_{noxa}}{22.4} \cdot \frac{21 - O_2^{ref}}{21 - O_2} \cdot C_{noxa}[ppm]$$

where:

C_{noxa} – volume concentrations of the analyzed noxes;

M_{noxa} – molar mass, in [mol];

O_2 – the oxygen content measured in the exhaust gases, in [%];

O_2^{ref} – the value for reference oxygen, in [%];

21 – oxygen concentration in air at the time of measurements, in [%].

RESULTS AND DISCUSSIONS

For the analysis of the noxes eliminated by the working equipments of the compound feed factory have been monitored the production processes of the assortments aimed for the Broiler chickens , in the three evolution phases: starter, growth and finishing.

The experimental measurements were performed on a time frame of 100 minutes, and the readings from the tables are average values for a period of 10 minutes, which in turn, at the end, will be mediated.

Table 1

The measurement results for the 3 assortments of compound feeds

Nr. crt.	Broiler – faza starter			Broiler – faza creștere			Broiler – faza finisare		
	CO [ppm]	**NO [ppm]**	**CO2 [%]**	**CO [ppm]**	**NO [ppm]**	**CO2 [%]**	**CO [ppm]**	**NO [ppm]**	**CO_2 [%]**
1	49	8	9.29	51	9	8.7	37	7	9.29
2	49	8	9.29	51	9	8.72	37	7	9.29
3	51	9	9.31	48	8	8.63	34	5	9.29
4	48	9	9.29	47	8	8.63	36	7	9.3
5	49	8	9.36	51	9	8.7	36	8	9.3
6	47	9	9.29	51	9	8.7	33	7	9.3
7	51	9	9.3	47	9	8.63	36	7	9.3
8	50	9	9.3	47	8	8.63	36	7	9.29
9	47	8	9.29	47	8	8.63	34	7	9.29
10	47	9	9.29	50	8	8.7	36	7	9.3
Media	**48.8**	**8.6**	**9.301**	**49**	**8.5**	**8.667**	**35.5**	**6.9**	**9.295**

Table 2

Measurement values expressed in mg/m^3N, reported at the reference oxygen of 3%

Nr. crt.	Broiler – faza starter			Broiler – faza creștere			Broiler – faza finisare		
	CO [mg/m^3_N]	**NO [mg/m^3_N]**	**CO2 [g/ m^3_N]**	**CO [mg/$m3_N$]**	**NOx [mg/$m3_N$]**	**CO2 [g/$m3_N$]**	**CO [mg/$m3_N$]**	**NOx [mg/$m3_N$]**	**CO2 [g/$m3_N$]**
1	61.25	16.42	182.44	63.75	18.47	170.85	46.25	14.37	182.44
2	61.25	16.42	182.44	63.75	18.47	171.24	46.25	14.37	182.44
3	63.75	18.47	182.83	60.00	16.42	169.48	42.50	10.26	182.44
4	60.00	18.47	182.44	58.75	16.42	169.48	45.00	14.37	182.63
5	61.25	16.42	183.81	63.75	18.47	170.85	45.00	16.42	182.63
6	58.75	18.47	182.44	63.75	18.47	170.85	41.25	14.37	182.63
7	63.75	18.47	182.63	58.75	18.47	169.48	45.00	14.37	182.63
8	62.50	18.47	182.63	58.75	16.42	169.48	45.00	14.37	182.44
9	58.75	16.42	182.44	58.75	16.42	169.48	42.50	14.37	182.44
10	58.75	18.47	182.44	62.50	16.42	170.85	45.00	14.37	182.63
Media	**61.00**	**17.65**	**182.65**	**61.25**	**17.45**	**170.20**	**44.38**	**14.16**	**182.54**

For a clearer and more suggestive analysis, in figures 7, 8 and 9 are presented, in graphical form, the measured values for the types of analyzed noxes which are eliminated in the air by the working installations from the compound feed factory.

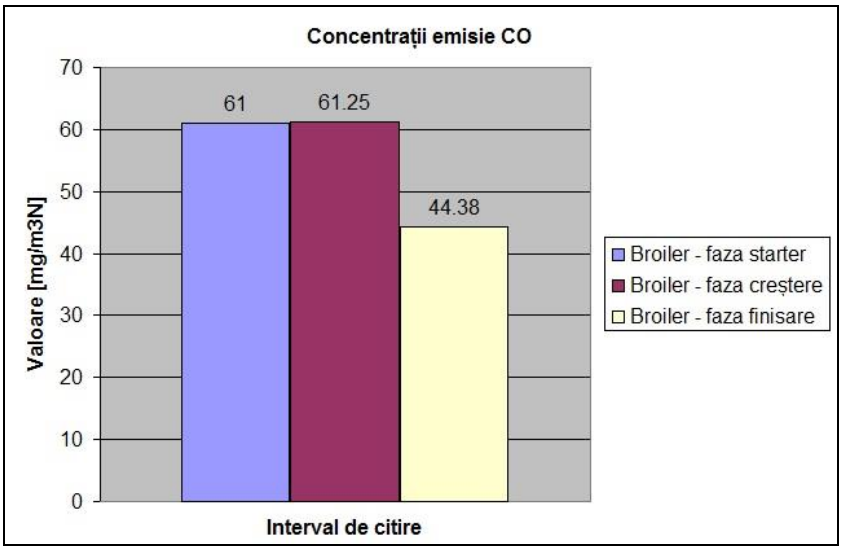

Figure 7 - The emission of CO reported to the reference oxygen for the three types of compound feeds

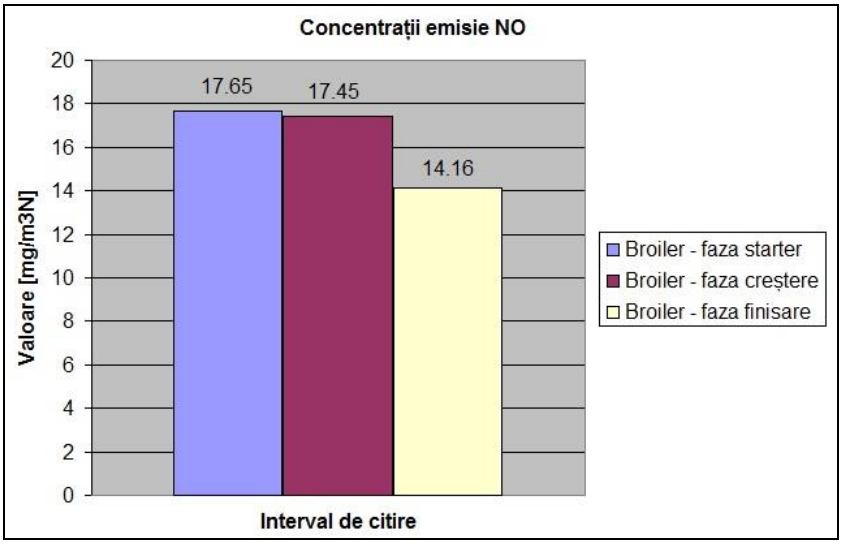

Figure 8 - The emission of NO reported to the reference oxygen for the three types of compound feeds

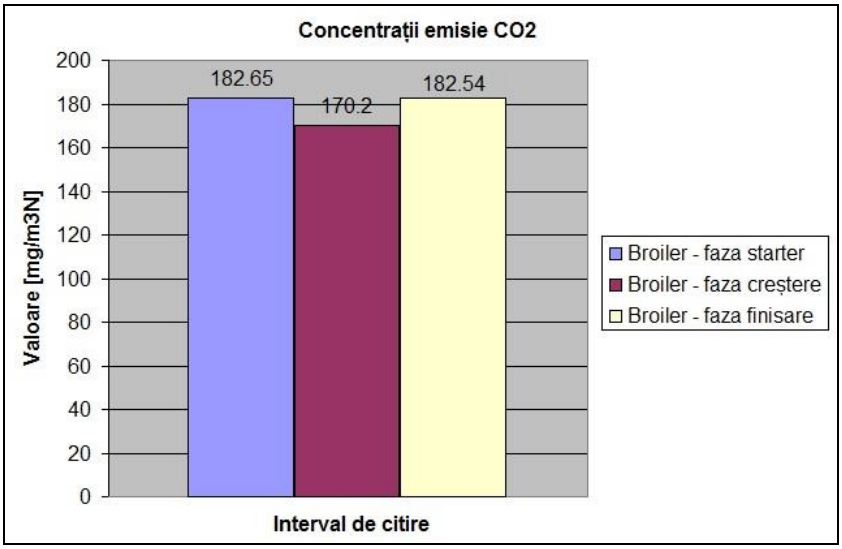

Figure 9 - The emission of CO_2 reported to the reference oxygen for the three types of compound feeds

CONCLUSIONS

The quality of the combustion gases is given in the first place by the conditions in which the burning takes place, on one hand, on the other hand the fuel type interfeers, and the third factor is the management of the burning.

The close values of the CO, NO and CO_2 emissions for the three assortments of compound feed indicate a high reliability of the operating of the steam generator.

The experimental measurements effectuated attest the good functioning of the working instalations and the filters with which they are equipped, by the fact that the determinated values do not exceed the limits established by the lesgislation in force.

The high sensitivity of the TESTO measuring device used gives a very accurate image of the exact evolution of the noxes in time. By analysing the values obtained, it can be noted that small differences from one type of compound feed to another appear, which indicates a very good setting of the working process.

The aim of conducting these measurements at the critical points of a working installations from a compound feed factory is to establish if these measured values are within the norms accepted by the European Union regarding the protection of the employed staff and of the environment.

BIBLIOGRAPHY

1. **Bollen, J.**, **Brink, C.**, 2014 - *Air pollution policy in Europe: Quantifying the interaction with greenhouse gases and climate change policies, Energy Economical*, pp 202–215;
2. **Bond T.C., Covert D.S., Kramlich J.C., Larson T.V., Charlson R.J.**, *Primary particle emissions from residential coal burning: Optical properties and size distributions, Journal of Geophysical Research: Atmospheres*, vol. 107, no. D21, pp 1-14, 2002 ;
3. **Gaceu L.**, 2006 - *Tehnici moderne de uscare a cerealelor si plantelor tehnice,* Editura Universitatii “Transilvania” Braşov, pp. 68-71;
4. **Heinsohn R.J. , Kabel R.L.**, 1999 - *Sources and Control of Air Pollution, Prentice Hall*, NJ, pp. 32-34;
5. **Ionel, I.**, 1994 - *Măsurarea emisiilor din gazele de ardere cu ajutorul senzorilor electrolitici,* The National Conference of Thermodynamics, Romania, Vol. I, pp. 231-235;
6. **Mihăilă, C.**, 2001 - *Procese şi instalaţii industriale de uscare,* Editura Tehnică, Romania, pp. 27-32;
7. **Popescu C**., 2016 - *The modification of some features of soils located nearby chemical plant Craiova zone that is affected by noxioux substances,* SGEM 2016 Conference Proceedings, vol. 2, pag. 409-415;
8. **Şara, A., Odagiu, A.**, 2005 - *Controlul calităţii nutreţurilor,* AcademicPres Publishing House, Romania, pp. 52-58;
9. **Vasile C.**, 2016 - *The implementation of an automated system of monitoring of the steam tempertures at the formation of compound feed granules,* Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, Vol. XLVI, no. 2;
10. **Vasile C.**, 2018 - *Studies about the automated control of steam temperature in the forming mold of the compound feed granules in view of environmental protection*, Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, Vol. XLVIII/2, ISSN: 1841-8317, pag. 425-430.