MONITORING THERMOTECHNICAL PARAMETERS OF THE PROCESSING INSTALLATIONS FROM A COMPOUND FEED FACTORY

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ABSTRACT

To satisfy the growing and diversified demand for food from the population, all compound feed factories propose to obtain finished products of the best possible quality, in the shortest time and at the lowest possible cost. Given the complexity of the activities performed during the technological flow from a compound feed factory, this article proposes monitoring the thermotechnical parameters of installations by made experimental measurements using sensors installed at critical points. The measurements shown in this article were made during the production of two compound feed types, because each recipe involves different work parameters. The scope of this monitoring of thermotechnical parameters is to confirm the reliability of the devices that ensure the automated control of the equipment, so as to respect the European Union norms regarding the protection of staff and the environment.

INTRODUCTION

All demographic statistics from recent years show an accelerated increase of population worldwide, which has automatically generated a growing demand for food. In this context, zootechnical farms knew an upward evolution due to the growing need of animal products.[5, 11] The feeding of the animals from these farms is done mainly with compound feed, because they provide an additional contribution of vitamins and proteins, so necessary to obtain the best possible productions.[8, 7, 9]

In this way, the compound feed factories knew a very fast development in recent years, each offering certain recipes of compound feeds depending on the age and species of the animals to be fed. Also, for resist on the competitive market, compound feed factories have been equipped with high-performance work installations, whose functional parameters are permanently controlled by automated and computerized devices, to ensure an increase in work productivity at a cost of cost as low as possible and at the same

time comply with the rules on staff safety and environmental protection required by European Union legislation.[3, 6, 9, 10]

On the route of the technological flow of production of compound feeds, are used quite often steam jets at very high temperatures, in activities of mixing the ingredients from the recipe produced, of homogenizing this mixture, of obtaining granules of different shapes and sizes when passing through the mold holes and of sterilization the granules which will be packaged as final product after their cooling. Thus, the steam generator is a very important component of the working installations in a compound feed factory (CFF), because it produces high temperature steam jets with values between 150-180°C.[7, 10,11]

The studies presented in this article aimed to monitoring thermotechnical parameters of the operating of work installations from a compound feed factory. For this, on the route of the technological flow were established 6 distinct critical points in which experimental measurements were performed starting from the steam generator burner and to the air jets used to cool the final product. Given that each compound feed recipe requires different thermotechnical parameters in the operation of the work installations, were analyzed the results of the measurements carried out during the technical process of producing two distinct types of compound feed, to verify the efficiency of automated and computerized control devices of equipment.

MATERIAL AND METHOD

The process of producing compound feeds involves performing several activities very well defined in time, with the help of calibrated and dedicated work installations to the pursued purpose. The technological flow corresponding to this complex process is shown schematically in figure 1. In addition to the main activities carried out in a compound feed factory in figure 1 were also indicated the critical points where the specialized devices used to make the experimental measurements were mounted.[1, 2, 10, 11]

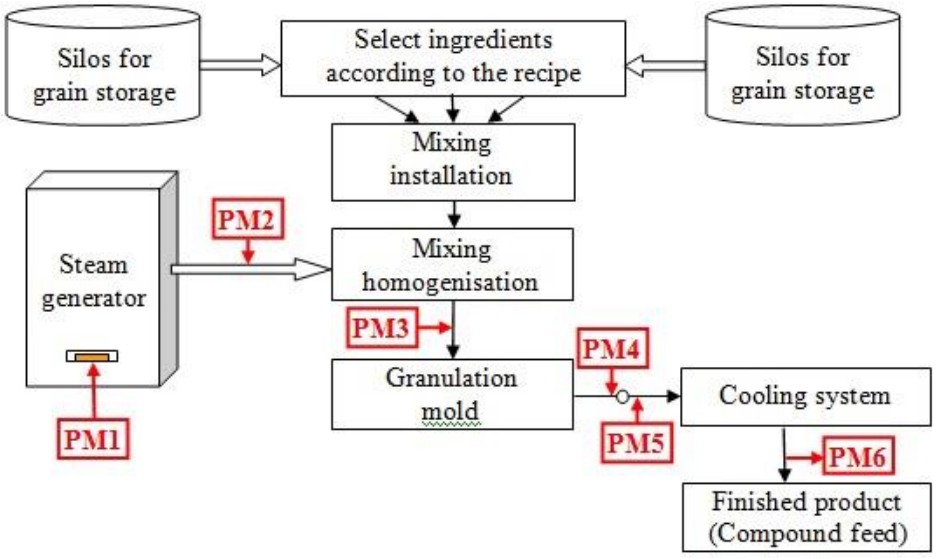

Figure 1: Technological flow from a compound feed factory and critical points where thermotechnical parameters were monitored

Analyzing figure 1 can be observed the 6 critical points in which the experimental measurements were performed:

- the first critical point (PM1) was established at the combustion installation incorporated in the steam generator;
- the second critical point (PM2) was located at the exit of the steam boiler;
- the third critical point for measurements (PM3) was established at the entrance to the mold where the mixed and homogenized product arrives, according to the manufacturing recipe. Here this mixture is treated with steam at a temperature of 150-180°C and a pressure of 7-8 bar;
- in the molds from the endowment of the work installations, the mixture obtained according to the desired recipe is pressed, this being thus passed through the orifices of the devices in order to form granules with different shapes and sizes. In these molds take place the formation and the hygenisation of the granules with the help of steam jets at very high temperatures. For a rapid decrease of temperatures in order to protect the environment is used a special filter in the form of a cooling buffer. In this area of the work installations was established the fourth point of experimental measurements (PM4);
- after their formation, the granules have a very high temperature, with values between 80-90°C. These are directed to the cooling

system, where is located the fifth critical point for measurements (PM5);

- the sixth measuring point (PM6) was located at the exit of the cooling system, where air jets are used which help to reduce the temperature of the granules to a temperature of approximately 26-28°C, which are permissible temperature values to protect the staff and the environment.The experimental measurements were made using specialized sensors and measuring instruments from the National Instruments data acquisition system. Their mounting at the critical points used in this study is shown in figure 3.

Figure 2: Installation of sensors and measuring devices at the critical points of the combined feed production technology flow

Considering the purpose of this study, for each assortment of compound feed, temperature measurements were made at the critical points of the technological flow necessary for monitoring thermodynamic parameters of the work installation.

All experimental measurements were performed over a period of 10 minutes, this being the set time period at the automated control devices to make an assortment of compound feed.[2, 4]

The results of these experimental measurements presented in the article allowed the monitoring of thermotechnical parameters of the working installations from the compound feed factory where the researches were carried out.

Based on the values recorded by the sensors and temperature probes installed in the critical points of the technological flow, the reliability of the working installations used can be demonstrated.[2] Thus, by using installations equipped with automated and

computerized control devices of their operation, it is possible a permanent monitoring the values of these thermotechnical parameters, which ensures compliance with European Union rules for environmental protection in terms of dust emissions, toxic substances and temperature.

RESULTS AND DISCUSSIONS

The studies and experimental research approached in this article are based on the results of measurements carried out at the steam boiler burner and at working installations where are used very high temperature steam jets for mixing and homogenizing cereals, proteins, vitamins and other ingredients according to the compound feed recipe to be produced, as well as for obtaining granules of different sizes and shapes when passing through molds and for sterilizing these granules as finished products.

The monitoring activities of the thermotechnical parameters corresponding to the work installations from the endowment of the compound feed factory were possible by performing the necessary experimental measurements in 6 different working points along the technological flow route.

The temperatures measured during these experimental researches performed on the technological flow route from an CFF will be noted as follows:

- flue gas temperature (T_FG),
- boiler steam temperature (T_BS),
- steam temperature at the entry of the mold (T_EM),
- buffer vessel temperature (T_BV),
- temperature at the cooling system (T_CS),
- environment temperature (T_E).

Must be mentioned that in the 6 critical points fixed on the route of compound feeds production were performed the necessary temperature measurements for this study with a frequency of one reading at 3 seconds. Because has been set a duration of 10 minutes for the technological process of obtaining an assortment of compound feed, it means that in the final file were obtained 200 values for the 6 monitored temperatures (figure 3 and figure 4).

Depending on the production recipe, the work installations register different thermotechnical parameters. But the automated control devices ensure that these thermotechnical parameters are kept within certain limits imposed by European environmental protection rules. To demonstrate the effectiveness of the use of

automated and computerized control equipment, experimental measurements were made for two assortments of compound feed: for feeding dairy cows and rabbits, respectively.

Table 1 shows some of the values of the temperatures measured during the production of the "dairy cows" type compound feed.

Table 1

Values of temperatures at the preparation of compound feeds for "dairy cows"

Time t [s]	Measured temperatures					
	T_FG	T_BS	T_EM	T_BV	T_CS	T_E
3	26.5	26.7	26.2	26	26	26
15	41	39	33	28.9	27.6	27.5
27	172	154	118	61	33	27.8
39	246	158	132	73	37	27.9
90	283	162	145	87	40.3	28.1
120	295	166	148	87,5	40.8	28.2
180	298	169	149	87.7	41.2	28.1
240	305	173	150	88	42,5	28.2
300	307	175	151.5	86.4	42.3	28.3
360	306	174	151.2	86.8	42.7	28.1
420	303	172	150,5	87	42	28
480	305	174.2	151.8	87.3	42.3	28.2
540	302	173.5	151	87	42.5	28.1
600	304	175	152	87	42.5	28.2

The numerical values shows in table 1 allowed a graphical representation of the evolution of the monitored temperatures for the work installation of the compound feed factory, in case of production process of the compound feed of "dairy cows" type (figure 3).

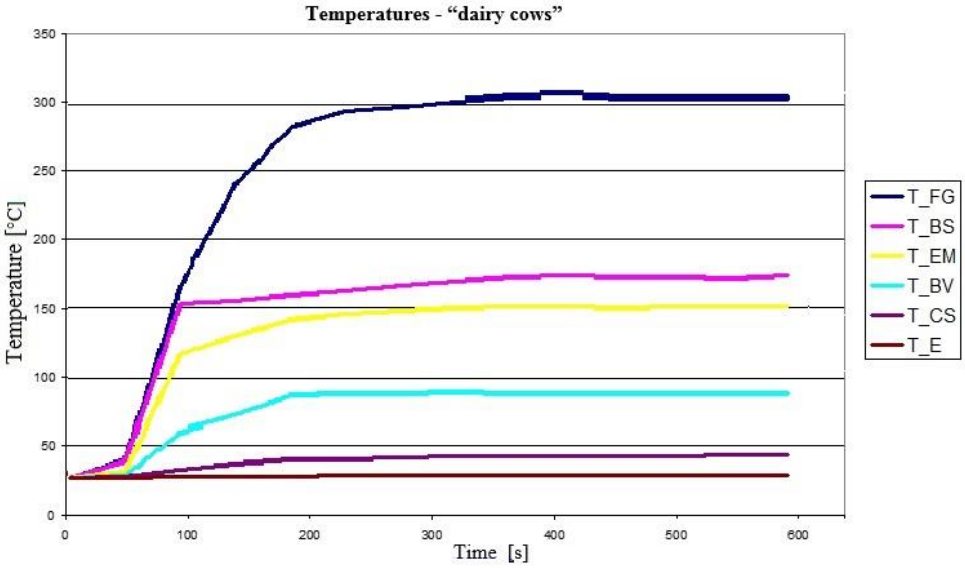

Figure 3: Evolution in time of the work installation temperatures at preparation of compound feed for "dairy cows"

The second set of experimental measurements were performed for the combined feed recipe used in feed from rabbit farms. Table 2 shows the values of the temperatures recorded by the measuring devices installed in the 6 critical points.

Table 2

Values of temperatures at the preparation of compound feeds for "rabbits"

Time t [s]	Measured temperatures					
	T_FG	T_BS	T_EM	T_BV	T_CS	T_E
3	26.3	26.6	26.2	26.1	26	26
15	39.8	39.2	31.7	28.6	26.9	26.7
27	166	153.2	117	59.6	32.1	27.3
39	238.4	156	130.6	71.5	36.3	27.5
90	281.2	159.8	142	85.8	39.8	27.8
120	294	163	145.9	86.8	40.4	28
180	297.1	167.6	148.1	87.2	41	28
240	302	170	149.8	88.1	41.7	28.1
300	304.8	173.7	151.3	87.6	42	28.2
360	305.9	174.9	151.4	87.3	42.5	28.1
420	303.7	173.1	150.2	87.1	42.2	28.2
480	304	173.8	151.6	87.3	42.2	28
540	303.6	172.2	150.9	86.8	42.6	28.2
600	304.2	174.5	151.8	87.2	42.7	28.3

Using the values recorded by the sensors and shown in table 2 was obtained a very clear graphical representation of the evolution of temperatures in the critical points of the work installation and in the case of the type "rabbits" compound feed assortment (figure 4).

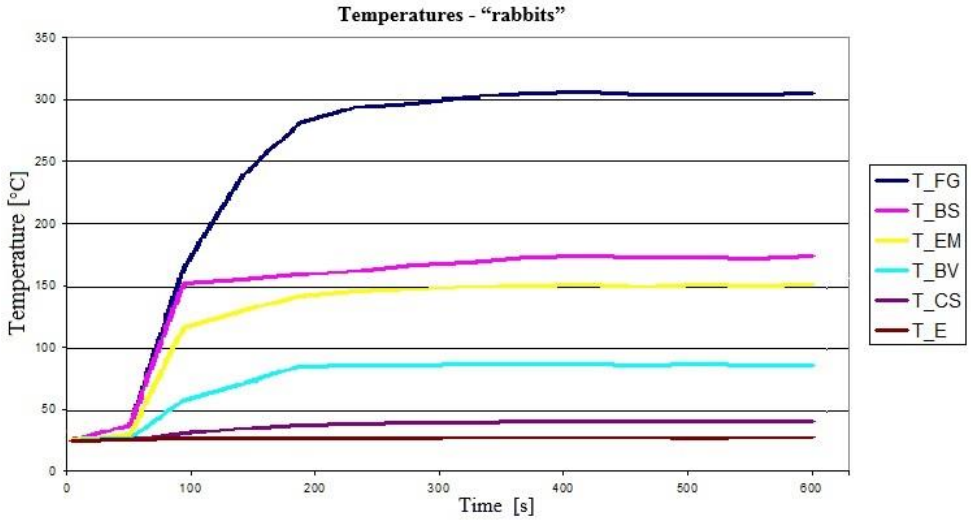

Figure 4: Evolution in time of the work installation temperatures at preparation of compound feed for "rabbits"

According the numerical values of the monitored temperatures can be observed the good operation of the equipment also for the second recipe of compound feeds, as well as the compliance with the reference parameters of the work installation due to the endowment with devices of automated and computerized control of the production technological flow.

CONCLUSIONS

The numerical values corresponding to the temperatures measured at the critical points along the technological flow path allowed a very important conclusion to be reached, namely that the work installation falls within the normal operating limits.

Evolution in time of the thermotechnical parameters represented in figures 3 and 4 confirmed that the operating regime of the compound feed production installation is constant, not being detected oscillations of the measured values for either of the two types of compound feed analyzed in these experimental researches.

Analyzing the graphical representations obtained, it can be easily observed that the values measured for the temperatures analyzed at the critical operating points on the technological flow route are very close to the reference values indicated in the technical book of the work installation from the compound feed factory where the experimental research were performed.

The two assortments produced during the experimental measurements required in this study met all the requirements of the beneficiaries in terms of quality, which confirms that the automation system ensures control at the parameters indicated by the producer of work installations used in the compound feed factory.

All the observations obtained from the analyzes and experimental measurements carried out confirm that the process of producing compound feeds must take place in factories equipped with high-performance work installations, with a high degree of automation and computerization, to ensure compliance with European Union rules on protection the staff and the environment.

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