ANNALS OF FACULTY ENGINEERING HUNEDOARA
- INTERNATIONAL JOURNAL OF ENGINEERING
Tome IX (Year 2011). Fascicule 3. (ISSN 1584 - 2673)

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RESEARCH TO IMPROVING THE MICROPELLETING PROCESS ON AGGLOMERATED TECHNOLOGICAL FLOW

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ABSTRACT: In this paper we analyze the possibilities of improving the process through micropelletizing humidity and time micropeletizing mixture. Data obtained from the practice we are processed in Excel and Matlab programs to obtain technological correlations, particularly between permeability and volumetric weight of the mixture, and humidity dependent parameters considered during micropelletizing and mixing, the parameters considered independent. The correlations obtained are representative of the process and permit the establishment of range for the independent parameters, which lead to the desired value (within the limits of technology) dependent parameters.
KEYWORDS: micropelleting, agglomerating, mixtures, correlations

INTRODUCTION

The agglomeration process takes place in primary drum mixing batches of overcrowding, and in secondary drum micropelletizing. Micropelletizing process is influenced by several factors, namely: chemical and mineralogical composition of the batch components, humidity, mixing time, grain shape, type and quantity of water used binders, mixture temperature, the structural characteristics of plants, etc. In practice it is aimed to achieve improved productivity in plants crowding, but at the same time and bonded with superior quality and features as possible with low energy consumption.

Micropelletizing process must ensure the maximum possible charge agglomeration permeability and volumetric weight, based on providing an optimal humidity and an optimal time of micropelletizing. Optimizing micropelletizing time is quite difficult operation, if it has to be determined so as to obtain both the technological and economical superior results.

EXPERIMENTS AND RESULTS

Determinations have been made to charge the following composition: 40% MKR, 5% concentrated Teliuc, 10% concentrated Capus, 25% Algeria ore and 20% ore India. We determined the permeability of the load and bulk weight. The results were processed in computer programs are presented below Microsoft Excel and Matlab.

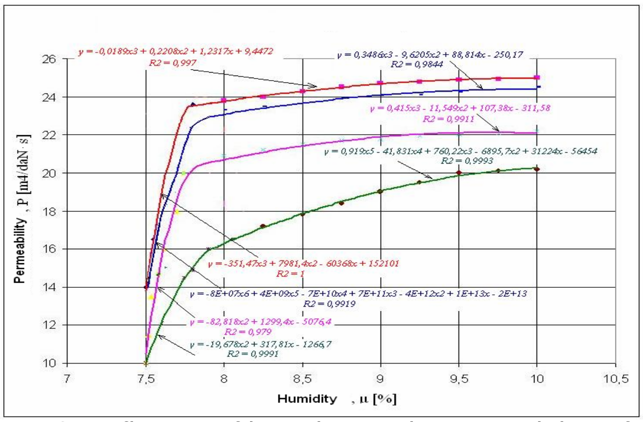

Fig.2 - Influence of humidity on the permeability of the load

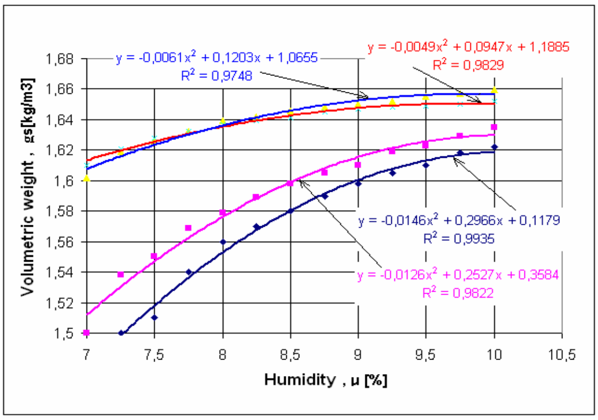

Fig.1. Influence of humidity on the volumetric weight of micropelletes

Graphical and analytical correlations obtained from processing data in Excel on the variation of humidity on the micropelletes volumetric weight is shown in figure 1 and the influence of humidity on the micropelletes permeability in figure 2. In figure 3 shows the effect of temperature on time micropeletizing mixture, and figure 4 shows the influence of humidity on micropeletizing time. Surface regression equation are:

$$G.v = 0.028802 \cdot u + 0.0054411 \cdot t + 1.3135,\ R^2 = 0.8528; \quad (a)$$

$$G.v = -\,0.009544 \cdot u^2 + 0.002737 \cdot u \cdot t + 0.000914 \cdot t^2 + 0.21638 \cdot u + 0.04829 \cdot t + 0.3367,\ R^2 = 0.9806; \quad (b)$$

$$G.v = 0.0038625 \cdot u^3 + 0.00076483 \cdot u^2 \cdot t + 0.00033749 \cdot u \cdot t^2 + 0.00013123 \cdot t^3 - 0.11511 \cdot u^2 + 0.022964 \cdot u \cdot t + 0.0002399 \cdot t^2 + 1.1974 \cdot u + 0.12838 \cdot t - 2.649;\ R^2 = 0.9971; \quad (c)$$

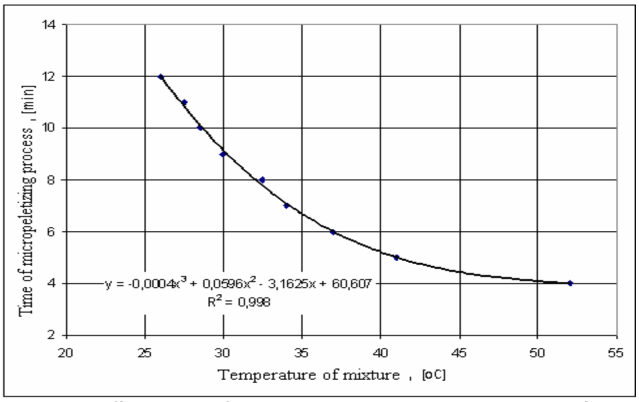

Fig.3 Influence of mixing temperature on time by micropelletizing process

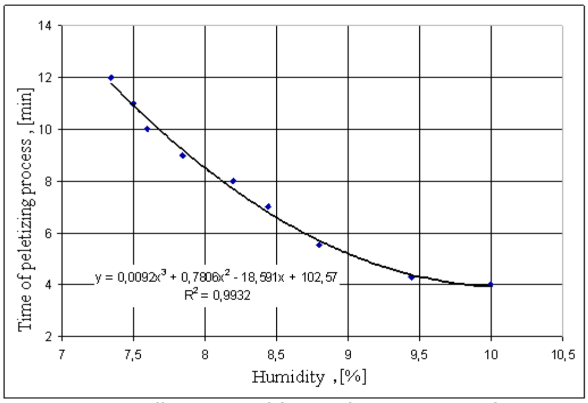

Fig.4 Influence of humidity on time by micropelletizing process

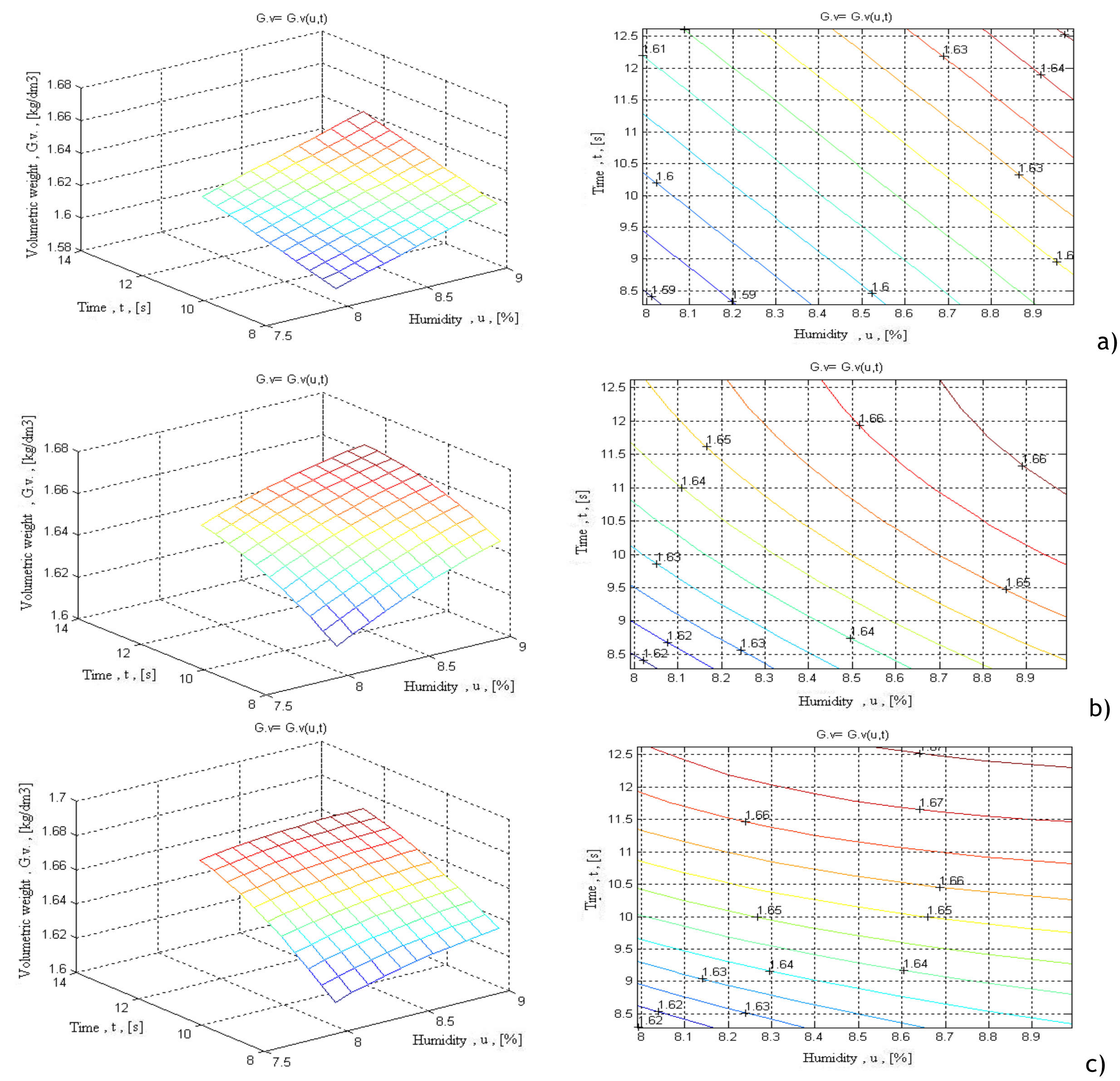

Fig. 5. Correlation permeability = f (moisture, time of micropelletizing process) ≥ 8% moisture
a) degree of correlation, b) correlation of grade 2, c) correlation of grade 3;

Regression surfaces depending on the time dependence of G.v and humidity is shown in figure 5. Surface regression equations are:

$$P = 8.9158 \cdot u + 0.48969 \cdot t - 57.6268; \quad R^2 = 0.9052; \qquad \text{(a)}$$

$$P = -9.6453 \cdot u^2 + 0.66021 \cdot u \cdot t + 0.02898 \cdot t^2 + 158.3149 \cdot u - 5.1496 \cdot t - 633.7825; \quad R^2 = 0.9612; \qquad \text{(b)}$$

$$P = 2.8727 \cdot u^3 - 1.6299 \cdot u^2 \cdot t + 0.24069 \cdot u \cdot t^2 - 0.0068105 \cdot t^3 - 58.2126 \cdot u^2 + 21.2592 \cdot u \cdot t - 1.6243 \cdot t^2 + 411.4445 \cdot u - 68.7127 \cdot t - 1011.6251, \; R^2 = 0.9877 \qquad \text{(c)}$$

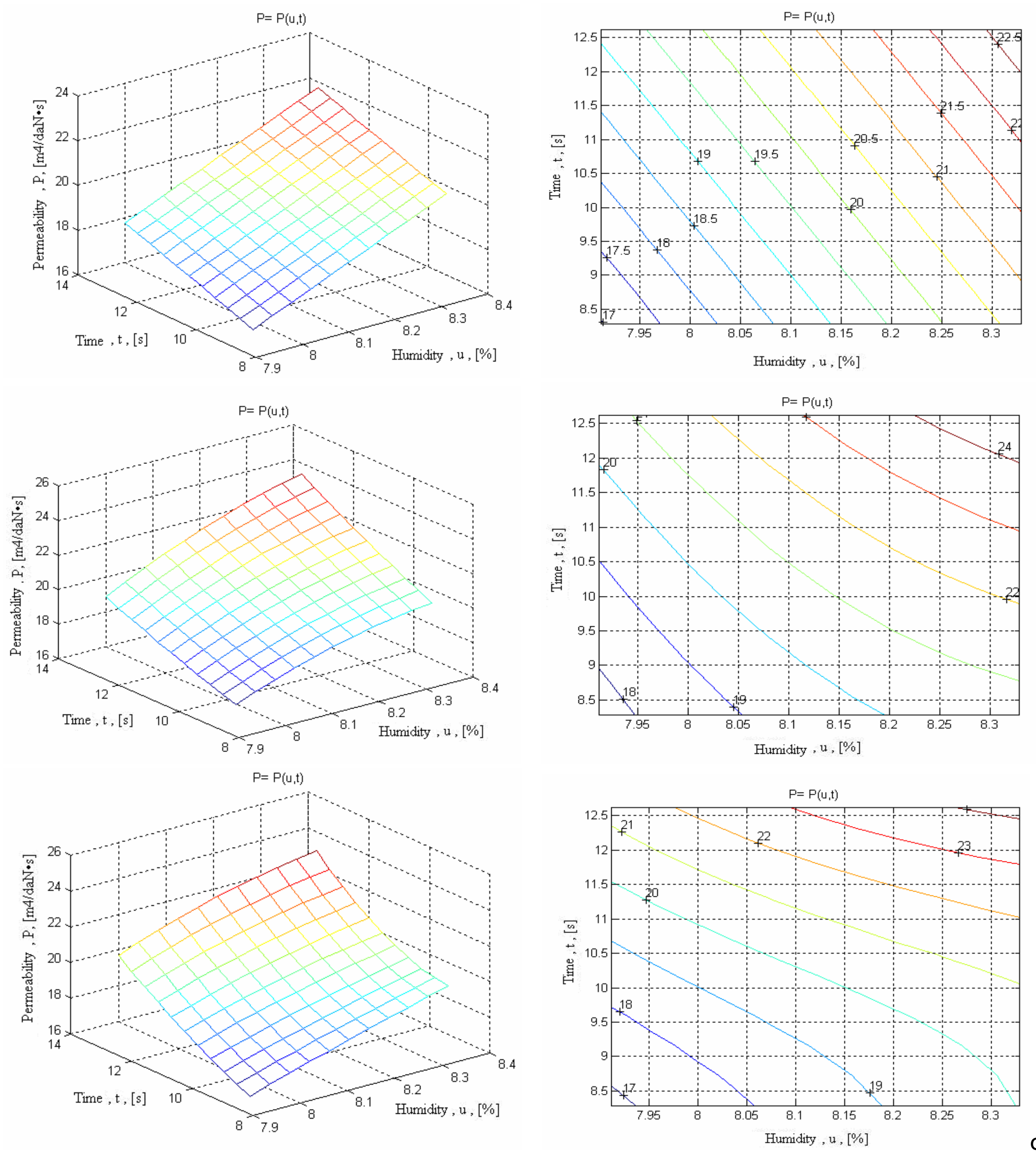

Fig. 6 Correlation permeability = f (moisture, time micropelletizing process) ≤ 8% moisture a) degree correlation, b) correlation of grade 2, c) correlation of grade 3;

Regression surfaces depending on the time dependence of P and humidity is shown in figure 6. Surface regression equations are:

$$P = 1.3821 \cdot u + 0.42956 \cdot t + 5.3573; \quad R^2 = 0.9372; \qquad \text{(a)}$$

$$P = -0.22342 \cdot u^2 - 0.054309 \cdot u \cdot t - 0.043014 \cdot t^2 + 5.6192 \cdot u + 1.8444 \cdot t - 18.4278; \quad R^2 = 0.9906; \qquad \text{(b)}$$

$$P = -0.011279 \cdot u^3 + 0.009733 \cdot u^2 \cdot t + 0.0042185 \cdot u \cdot t^2 + 0.0042537 \cdot t^3 + 0.062597 \cdot u^2 - 0.32478 \cdot u \cdot t + 0.048098 \cdot t^2 + 3.6 \cdot u + 2.3499 \cdot t - 12.2996); \quad R^2 = 0.9926; \qquad \text{(c)}$$

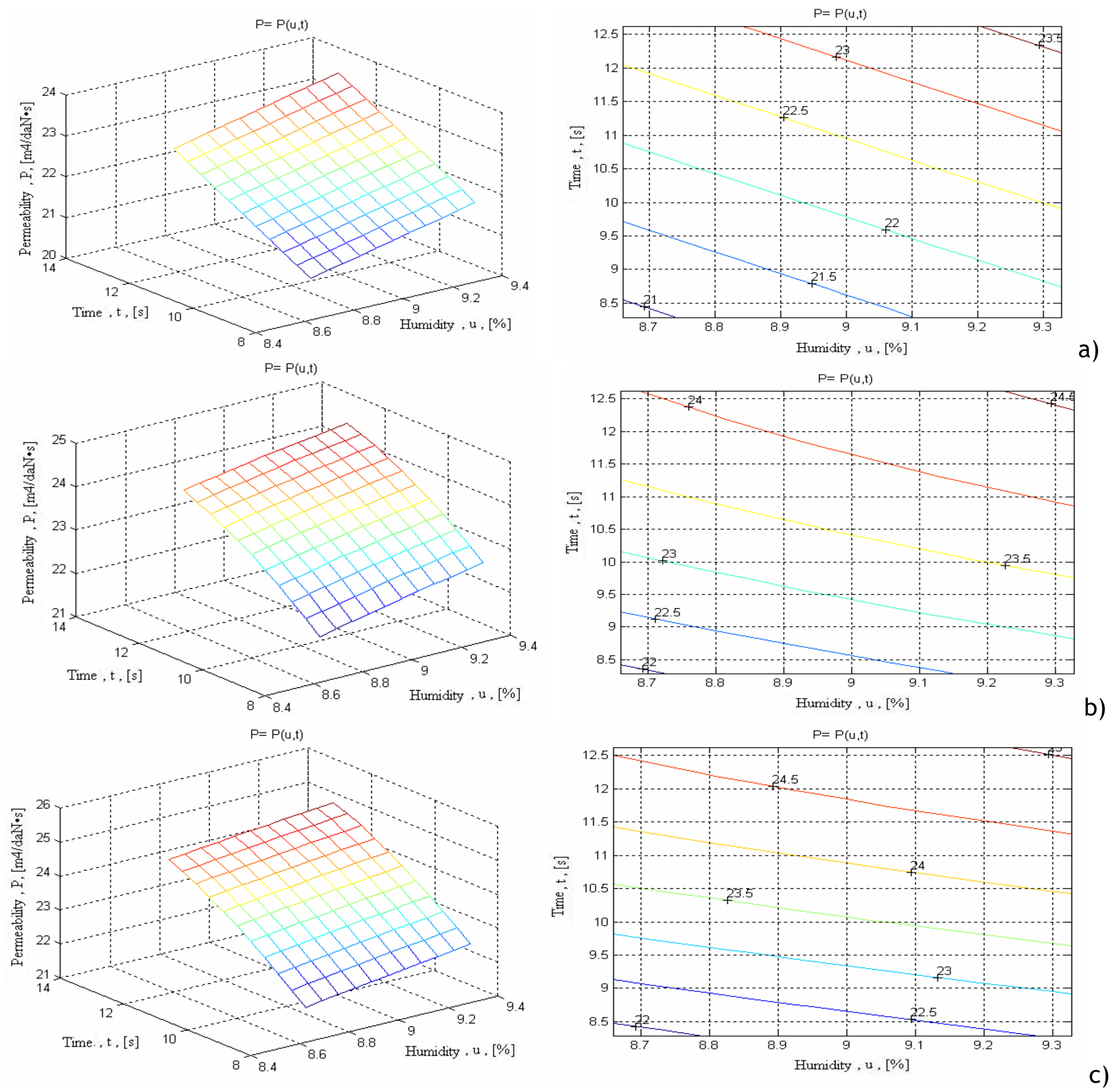

Fig. 7 Correlation permeability = f (moisture, time of micropelletizing process) ≥ 8% moisture a) degree correlation, b) correlation of grade 2, c) correlation of grade 3;

❖ ANALYSIS RESULTS

From figure 1. it is found that with increasing humidity of the mixture subjected micropelletizing process increases the volumetric weight, and reaches a maximum at a time, an amount of moisture which allows a maximum volumetric weight of the mixture subjected micropelletizing , micropelletizing process vary with time, but its duration is at the technological limits, according to data presented in table 1. Following are the maximum values for bulk weight gain [from 1.6239 to 1.6585], if the humidity is contained within the limits of 9.90-10.15% for time limits micropelletizing process in 4-17 min.

Table 1.

Number character	Time - t (min)	Humidity - u (%)	Volumetric weight - Gv (kg/dm^3)
1	4	10.15	1.6239
2	6	10.037	1.6254
3	10	9.94	1.6585
4	17	9.98	1.6455

Also notice that the graphic representation of displacement curves for a variation of weight for 10 min and 17 min almost coincide due to micropelletizing process not justify a longer than 10 min. The mentioned values of R very close to 1, which confirms the validity of the correlations established.

The graphic representations shown in fig. 2, leading to the assertion that with increasing humidity increases the permeability micropelletizing mixture, and lasting growth is dependent micropelletizing process. To establish the dependence of moisture permeability depending (for different values of micropelletizing process time) the variation of moisture content was divided into two sub domains. Depending on the length was determined for each sub domain correlation equations, and graphical representations to the limits shown in table 2.

The graphical representations are associated sub domain I noticed a sharp increase (intense) pronounced with increasing moisture permeability. The increase is less pronounced for t = 4 minutes, compared with other times of micropelletizing process. The correlations related sub domain II.

Table 2.

Number character	Time - t (min)	Subdomain 1 - humidity - u (%)	Subdomain 2 - humidity - u (%)
1	4	≤ 7.75	≥ 7.75
2	6	≤ 7.80	≥ 7.80
3	10	≤ 7.85	≥ 7.85
4	17	≤ 7.90	≥ 7.90

It found a slight increase in moisture permeability with the increase, most pronounced being increased for the duration micropelletizing process there is 4 min. Just as with the weight of maximum displacement are obtained for different values of moisture permeability, the data are presented in table 3 and table 4.

Table 3.

Number character	Time - t (min)	Humidity - u_1 (%)	Permeability - P_1 (m^4/daN·s)
1	4	10.33	20.34
2	6	9.68	22.113
3	10	9.97	24.39
4	17	10.17	24.97

Table 4.

Number character	Time - t (min)	Humidity - u_2 (%)	Permeability - P_2 (m^4/daN·s)
1	4	8.07	16.50
2	6	7.84	20.44
3	10	7.68	21.04
4	17	7.85	21.42

Humidity values are very close to those achieved if the volumetric weight (sometimes the differences are insignificant). For the micropelletizing duration of 10 min and respectively 17 min, the permeability values obtained are very close so it does not justify a period of micropelletizing over 10 min.

If using warm batch of micropelletizing return, with the increasing temperature reduces the time needed micropelletizing mixture (fig. 3). From the point of view it shows a decrease tehnologic explained that by obtaining more favorable conditions for bridges between the granules.

Technology that allowed the correlation between a minimum, the mixture of 52.7530 C temperature and results in pelleting of 3.97 minutes duration.

From fig. 4 it follows that to obtain a mixture in the cold if it imposed weight, during the pellet is reduced with the increase moisture mixture. The correlation curve shows a minimum humidity of 9.92, it follows a pelleting time of 3.95 minutes.

As we have previously presented data were processed in Matlab program to obtain multiple correlations (one dependent and two independent parameters), obtaining 1.2 and 3 degree correlations, which are presented below as both graphics and analytical.

It also presents the correlation coefficient values for R and S from the surface deviation of correlation.

Graphical representations of data obtained by processing in Matlab computer program allows us to establish the limits of variation for moisture and time to obtain a weight micropelletizing volumetric permeability that a desired / required.

❖ CONCLUSIONS

Based on the results obtained and presented above, we conclude the following:

- both for processing data in Excel and in Matlab, correlation coefficients, are more than 0.90 and in many cases close to 1, which ensure that obtained relationships and graphic representations, reflect the reality of practice;
- on the moisture content is appropriate for it to be included in the limits of 9.5 - 10.5%, limits that provide superior value for bulk weight and permeability;
- the range proposed for moisture allows adjustment without its difficulties, for technology;
- micropellets length of time should not exceed 10 minutes, shown to vary in the range 8-10 min.

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