RESEARCH RELATED TO THE VAGUE LOGICS APPLIED TO THE ADJUSTMENT OF THE DRYING SYSTEM OF THE BARLEY

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Abstract

In the case of the study of the adjustment features of the barley's drying system it is necessary to issue a numerical model which has the ability to simulate the functioning of the heat changers and of the barley dryer as well as their thermodynamic features. The adjustment of the heat system for a cereal dryer with water needs the use of a programmer. The relaunching and heating laws are based on the fuzzy variable logics (vague).

Key words: barley dryer, vague logics, programmer, variable under assembly

INTRODUCTION

The drying of the barley is realized in a current of warm air and from the point of view of the water removal dynamics it includes, regardless of the type of dryer used, two stages: (Iancu C, 2010, utilaje în industria alimentară, Ioancea l., 1986. maşini, utilaje şi instalaţii din industria alimentară,)

In the drying stage, which is the first one, from the initial humidity of the green malt of 40-48% until the humidity of 19% (the wet ability point) the removal of the water is easily performed at low temperatures and the used air is saturated in humidity (cp=100%); in this stage the malt behaves like a water surface and the air drying's potential is entirely used.

In the second stage of drying, from the wet ability point until the 3-4% humidity in the case of the blond malt and until 1,5-3% for the brown one, the malt releases harder and harder the humidity because it acts contrary to the capillary and colloidal forces so it is necessary to increase the temperature of the drying air; once the humidity of the barley has decreased from 19% and until the final humidity there is also a decrease of the relative humidity of the used air thus its drying potential also decreases.

When the malt reaches a humidity of approximately 2% it reaches a stable balance which cannot be moved but only if using drying temperatures over 100°C.

From a technological point of view we can distinguish two such stages of malt drying:

Withering (pre drying) - which consists in removing the water from the green malt at low temperatures until a humidity of 10% in the case of the blond malt and until 20% in the case of the brown malt; This first stage includes the drying until the wet ability point mention above.

The actual drying (final) - which consists in removing the water from the barley at higher temperatures, of 80-85 °C in the case of the blond malt and of 100-105°C in the case of the brown malt until they reach the humidities appropriate to the two types of malt.

MATERIAL AND METHOD

The adjustment of the drying system in the inside of a cereal dryer needs the use of a programmer. The relaunching and heating laws are based on the fuzzy variable logics (vague) (A. Bara: "Sisteme Fuzzy2001, Carmen Jover, Carlos F. Alastruey: "Multivariable control, 2006, ErtuğrulÇam: "Application of fuzzy logic, 2007).

The Td launching temperature of the warm water circuit has as determinative factors different stages of intermittence, the interruption of the heat when the device's places are not occupied, the superior adjustment during the occupation period, the inferior adjustment and the Tcb basic consignment. (F. S. Blaga,: "Teoria Sistemelor şi Reglaj Automat"2009, Iancu Carmen, Modeling the regulation of the malt drying 2010)

The induction mechanism adapts the parameters of the heating and relaunching laws automatically..

The interruption of the heat in case of over heating has been performed with the help of a function introduced in the programmer, and it intervenes in the final part of the occupation period. The superior adjustment is of the open loop type. The heating law determines the Td launching temperature according to two observation variables:

$$E_{tat}(t) = \frac{1}{\frac{k_1}{delt} + k_2} \times \left\{ \frac{k_1}{delt} \times E_{tat}t\left(t - 1 + k_2 \times T_{ch}\right) \right\} \quad (1)$$

- The external temperature Te
- The thermic estate of the E_{tat} building expressed through the relation:

where:
delt – the time interval in hours;
k_1 and k_2 – constant coefficients.

This expression is the result of a temporal discrepancy of the analogical model for which the non-capacitive knot corresponds to the interior environment and the capacitive knot corresponds to the structure of the building. The evolution of the E_{tat} variable corresponds with the approximate form of the building structure's temperature affecting the Ta air interior volume.

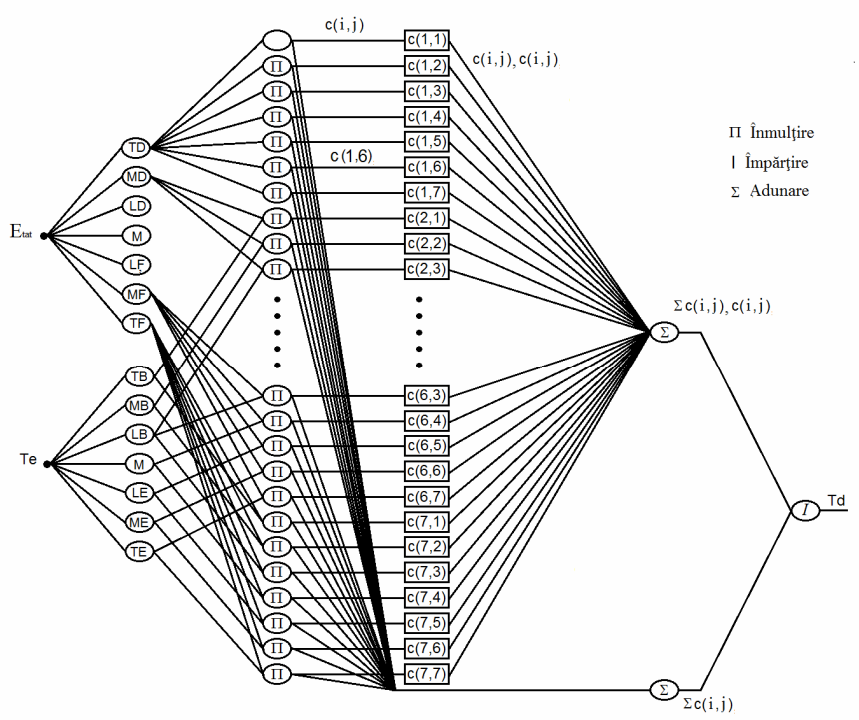

Fig. 1. The structure of the interference system conexions, with random reasoning

Each under variable assembly (vague) is indicated through a linguistic table:

- E_{tat}: Very detrimental (TD); detrimental environment (MD), slightly detrimental (LD), average (M); slightly favorable (LF), average favorable (MF), very favorable (TF).
- T_e: very low (TB); low environment (MB); slightly low (LB); average (M); slightly high (LE); high environment(ME); very high (TE).

The basic exterior temperature is considered the minimum value for Te. The maximum value is represented by the T_{ch} high consignment temperature

RESULTS AND DISSCUSIONS

The E_{tat} function is increasing in the occupation period and decreasing when the heating is turned off because T_{ch} is then replaced by T_a in the (1 relation. The minimum value of the E_{tat} corresponds with the detrimental thermic estate (”cold” building). The maximum value corresponds with the estate in which the building has reached a stable energetic level (”warm” building). The k_1 and k_2 coefficients have been approximately determined from the way of obtaining the E_{tat} evolution.

The E_{ta}t variable has not got a rigorous character. This character and the research of a non linear law has been especially done by the law of radiation emission which led to the use of the variable command.(vague).

The vague interference (variable) is of the TAKAGI-SUGENO type of 0 order. It debates a particular family for which the conclusions of the rules are the constants. The variable assemblies (vague) used for the Ta and Etat variables are triangles, their number varying between 2 and 7.

The general structure of the variable interference system (vague), when 7 vague assemblies (variables) are used for each of the two observation variables is presented in figure 1. The studied structure is of a conexion type as it resembles the neuron nets. A combination of two variable under assemblies (vague) belonging to each of the two variables is established through an (i;p) rule whose activation degree λ(i,j) corresponds to the product of the two functions of appurtenance evaluated for this rule. The i and j indexes correspond to the (vague) relative variable under assemblies E_{tat} and Ta.

$$\alpha(1,6) = \mu_{TD}(E_{tat}) \cdot \mu_{ME}(T_e) \qquad (2)$$

With the help of this structure one can visualize the different stages of calculus. It starts from two numerical variables of arrival and observation. The u appurtenance function of the Ta and E_{tat} variables and of the different variable under assemblies (vague) is calculated for each of the entries.

CONCLUSIONS

A combination of two variable under assemblies (vague) belonging to each of the two variables is established through an (i;p) rule whose activation degree λ(i,j) corresponds to the product of the two functions of appurtenance evaluated for this rule. The i and j indexes correspond to the (vague) relative variable under assemblies E_{tat} and Ta.

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