Astract of the Theses:

STUDIES AND RESEARCH ON IMPROVING THE CONSTRUCTIVE AND FUNCTIONAL WHEAT MILLS FOR PRIVATE HOUSEHOLDS

The milling of the grain is one of the oldest occupation of the handicraftsman, a long time ago the milling equipment developed in the same time with general progress of the world through the application of the some proceedings and high performance technologies .

Nationally and internationally theoretical and experimental research concerning to correlation functional parameters with constructive and energetics parameters of equipments from the milling industry taked wide ampleness. The quality and safety of the products is a major objective for manufacturers, as well a, a right for consumers. Enroling in this tendency, of obtain high quality finite products with low costs, doctoral thesis purposed, as well as, mean objective the constructive and functional improvement of wheat mills for private households.

The paper elaborate as well as doctoral thesis has summary of the thesis, five chapters and bibliography list with representative literature in domain, contain and paper worked by author. The five chapters has 221 pages, where are included 172 graphics and 48 tables.

The PhD thesis is structured in **introduction**, *first part* containing current stage at global and national level related to milling processes and equipments and *second part*, containing the experimented wheat mills, techniques of measurement and conclusions.

The *second chapter* present „***Current stage at global and national level related to milling processes and equipments***" which is based on the bibliografy study , discussion with experts in millind domain and people which use the wheat mills.

Principal aspects presented in this chapter appertain to following:

- Processes and machinery for the cleaning and selection grain:
  - Separation of impurities after dimensions;
  - Separation of impurities after aerodynamical properties;
  - Mixed separation of impurities after dimensions and aerodynamic properties;
  - Separation of impurities by density;
  - Separation of impurities after magnetic properties;
  - Impurities of separation from grain wheat.
- Hidric processing of cereal in milling industry:
  - Role and effects of hidric processing;

- Method of hidric processing.

- Technological scheme for the preparation of cereals concerning milling process.
- Milling process:
  - Milling by roller mills;
  - Elements of calculus and construction of roller mills;
  - Auxiliary machines used in milling process.
- The sorting of milling products:
  - Sorting by sifting;
  - Sorting by semolina machine.
- Conveying of products in mill:
  - Gravity transport;
  - Mechanical transport;
  - Pneumatic transport.
- Aspiration in mill:
  - Aspiration in cleaning;
  - Aspiration in milling-sieving section.
- Technological diagrame:
  - Specific elements which are at the base of the setting up of milling product diagrame;
  - Calculation of : roller mills length, total surface of plansifters and of semolina machine width;
  - Examples of milling product diagram.
- Examples of arrangement wheat mills.
- The villages mills from Romania.

In the *third chapter* „***The constructive and functional improvment of wheat mills***”, are presented wheat mills designed. The milling of wheat is a complex technological process which demand a strict flux, respective a performance technological line.

I designed and analysed the following wheat mills:

- MG 400, which contain in technological scheme one separator aspirator, intensive hullers, one brushing machine, one partitioned double roller mill, with milling rollers ∅ 250 mm (diameter) x 800 mm (length) and one plan sieve with four sifting passage. The partitioned double roller mill has two identical parts set simetrically opposite of the vertical plane. Each part realize two milling passage;
- MG 10P, which contain in technological scheme one separator aspirator, intensive

hullers, one indented cylinder, three double roller mills, with milling rollers ∅ 250 mm (diameter) x 400 mm (length) and one plan sieve with six sifting passage.

- MG 25P, which contain in technological scheme one separator aspirator, intensive hullers, one indented cylinder, three double roller mills, with milling rollers ∅ 250 mm (diameter) x 800 mm (length) and one plan sieve with eight sifting passage.
- MG 30P, which contain in technological scheme one separator aspirator, intensive hullers, one indented cylinder, one stone separator, three double roller mills, with milling rollers ∅ 250 mm (diameter) x 800 mm (length) and one square plan sieves with six sifting passage and one bran finisher.
- MG 10P, which contain in technological scheme one separator aspirator, intensive hullers, one stone separator, four double roller mills, with milling rollers ∅ 250 mm (diameter) x 800 mm (length), one plan sieve with eight sifting passage and one plan sieve with six sifting passage.

The research on these wheat mills, I releazed at IMA SA Iasi and theirs place operator.

- locality Gârbovi, county Ialomița , for wheat mill type MG 400;
- locality Brăila, county Brăila , for wheat mill type MG 10P;
- locality Grindu, county Ialomița , for wheat mill type MG 25P;
- locality Tecuci, county Galați , for wheat mill type MG 30P;
- locality Pucioasa, county Dâmbovița , for wheat mill type MG 35P;

, where the mills working.

The *chapter four* "***The experimentation of wheat mills designed and achieved***", contain apparatus and appliances used at tests, preliminary operational verification and determinations effected on designed mills.

After achieved adjustments and correlated working capacity, at wheat mills I effected the following determinatios:

- accuracy and cleaning capacity;
- kinematic parameters and technological effect of the scourer;
- kinematic and structural parameters of the brushing machine;
- reduction technological effect of minerals content in processing wheat with stone separator;
- parameters of the aspiration installation;
- efficiency of the magnetic separators;
- milling capacity and technological parameters achieved with the partitioned double roller mill VD-00/C;

- structural and working parameters of the roller mill type VDU825;
- pneumatic transport capacity of the installation;
- working capacity and technological parameter of the mills;
- the energetic specific consumption per finite product unit;
- the costs for the investment of the achievement of the mill.

At all the wheat mill designed and achieved, I had in view to implement systems HACCP, (Hazard Analysis Critical Control Point), EHEDG (European Hygienic Engineering Design Group). These concepts assure conditions needed to implementation of the concept of total quality management (TQM). In the work paper are defined the terms for the implementation concrete conditions of the food safety and quality standards for small unit of wheat processing.

The diagram of wheat milling process, can be grouped in four distinct sectors (*fig.1*).

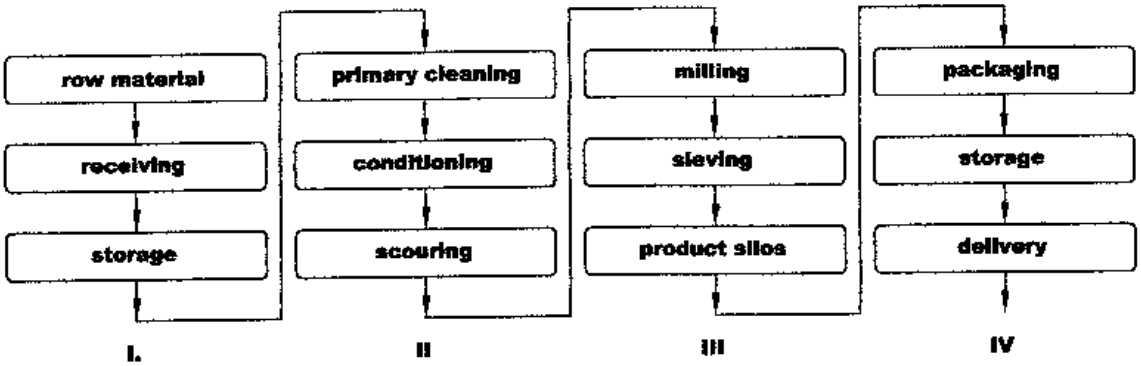

Fig.1. The diagram of wheat milling process: I - sector for receiving and storage raw material; II - sector for the cleaning and the conditioning of the grain; III - sector for milling-sieving and bulk storage of the finit products; IV - sector for packing, storage finit products and delivery.

The machinery and the equipments have been grouped on modules depending on technological operation which is to be achieved.

The module for the cleaning of wheat includes: aspirator separator; intensive hullers, stone separator, indented cylinders, brushing machine and turboseparator. This technologic module achieves the separation of the impurities after dimension and specific weight, taking off the mineral dust, remaining straws and the beards of the wheat grain surface.

The conditioning module includes the humectation installation, the humidity unifier, the bunker with cells for resting, intensive huller and turboseparator. The humectation installation achieves the adjustment of the wheat humidity on levels: the humectation of conditioning and the humectation of milling. The water flow needed of the humectation it is depending on operation capacity of installation, initial humidity and finale humidity.

For the repeated grinding produce, the finite produce, the flour, it can obtain through the

passing of the produce successively through more much rolls pairs, mounted in roller mill.

Before to enter, in roller mill, the previous produce, separated through sifting, in the diversely fractions, including the flour, which except of the flour it is distributed towards a new roller mill. It can reach, repeatedly to the intensive separation of the covering of endosperm and to the obtaining of finite produce.

The sieve for sifting has the role to assure the sorting of the grain milling in several fractions of the same or different granulations. The number of the fractions is established by the milling diagram and depending on this one, it can organize the interior scheme of the compartments from a passage.

The transport of the products between roller mills and sieves is pneumatically.

Analysis the results of the experimental tests, as well as the behaviour of these type of wheat mills in the exploitation conditions, it resulted a series of **conclusions**, presented in chapter 5, such as:

1. For the achievement of the increase of the technical and technological parameters at the wheat mills for private households, it has been effected assessments and it has been analysis, having in view the respecting of the milling process at the existing mills. After this analysis, it was obtained the following negative aspects:

- the flour does not correspond to the present requirements of the food safety and quality standards;
- the building where are placed the mills have up 11m, so that, the costs for investment being very high;
- the observation of the equipment is very difficult;
- the access for intervention is very difficult and there is risk of accidents;
- the energetic specific consumption per milling product unit is high;
- the equipments for the making up of mills has reduced technical performances and low reliability;
- the impact of the mills about environment is negative.

2. On the basis of these considerations and following the improvement of technical and technological performances I redesigned the wheat mills from private households with 9÷35 to wheat /24h , so that, the equipments and installations is to be placed horizontally on a concreted platform and without special foundation.

The construction of the wheat mills as modules disposed horizontally self tackling have following advantages:

- the costs of the achievement of the building where is to mount the modulated mill on horizontally decreases with at least 30%, because of the erection height decreases from 11-12 m at maximum 6,5m ;
- to admit location in existing building, by realizing others disposition of equipments;
- the erection time to purchase is reduced at half;
- it decreases the risks of accidents apparition;
- it decreases the number of workers needed for mills employment.
- the surveying of the mill, the maintenance and the repairing of the machinery are achieved more comfortable as the whole activity is running on only one platform, opposite to the classical mills which are mounted on at least 2-3 levels;
- milling and sifting parts are achieved as two modules and the transport of the milling between them is pneumatically. Through this solution is assured a good cooling of the rolls and it avoid the condensation water both in roller mills and transport pipes;
- the flour quality increases substantially, the operating conditions of the mill are very much improved due to the using the pneumatic transport for the transfer of the intermediate products between roller mills and sifting sieve;
- the flexible technological flow permit development working capacity without high costs.

3. The partitioned double roller mill type VD-00/C, with milling rollers ϕ250 mm (diameter) x 800 mm (length), designed and achieved , substitute with success the working of two double roller mill VDU400, with milling rollers ϕ 250 mm (diameter) x 400 mm (length). The technological parameters of the partitioned double roller mill are similars the parameters achieved with two double roller mill VDU400. Is obtained a midle value of the specific charge with product of 61,32 [kg · 24 hours / cm length of the milling rollers] at one specific consumption of electrical energy per grist of 0,0344 [kWh / kg] . At the wheat mill type MG 400 by utilization of the partitioned double roller mil type VD-00/C is obtained a extraction coefficient of total white wheat flour for bakery of 70%.

For nearly 402 [kg wheat /h] capacity, the drive of two double roller mills type VDU400 is ontained from four electric motors with each power 5,5 [kW] , the drive of the partitioned double roller mill type VD-00/C is obtained from two electric motors with each power 7,5 [kW], so that by utilization of the partitioned double roller mill it decreases the energetical consumption with 7 [kW h] .

The cost for execution of one partitioned double roller mill type VD-00/C is equal with approximate to 65% from the costs value for execution of two double roller mills type VD400.

The space occupied of one partitioned double roller mill type VD-00/C is smoler than the space occupied of two double roller mills type VD400.

4. At the designed and the execution of wheat mills I effected optimization the following structural and technological parameters:

- working capacity;
- the component parts and the technological flow diagram characteristics;
- the structural and functional parameters specifics every component machines;
- the space and concrete conditions where are placed the mills;
- the mode of arrangement of the machinery;
- the extraction coefficient and the finite products quality;
- the feeding mode of the mills;
- the collecting mode of the finite products;
- the impact of the mills about environment;
- mounting possibility existing at customer;
- the energetical specific consumption per finite product unit.

et al. factors which determine in order that each wheat mills to be distinctive.

5. At the wheat mills designed and achieved I obtained the following technological parameters:

- the average working capacities included between 402 and 1378 [kg/h] grist per hour;
- the average specific milling charges included between 42,3 kg and 62,5 [kg · 24 h / cm length of the milling rollers];
- the average sifting specific capacities included between 944,9 and 1250 [kg · 24h / m^2 sieve surface]
- the specific consumptions of electrical energy included between 0,057 and 0,071 [kWh / kg grist];
- the extraction coefficients of total white wheat flour for bakery included between 70 % and 75 % .

6. Analyzing the obtained results at the tests it can conclude that the designed and achieved wheat mills, satisfy the requirements imposed both concerning the quality finite products of the minimum energetical consumption and conditions of the food safety standards.

7. Analyzing the obtained results it can conclude that the wheat mills designed achieved and tested are complex machinery, which are able to high performances, reduced exploitation costs and are ideal for private households.