RESEARCH RELATED TO THE MALT DRYING USING GEOTHERMAL WATER

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Abstract

This work presents a new method to dry the malt using geothermal water. This thing is possible if the geothermal fluid has a temperature and a pressure high enough; if the temperature is not high enough it can only be used for a part of the processing aspects or as additional heat to cover all the thermic energy needs of the processes.

The geothermal energy can be integrated in an industrial process, in two applications: either as a means of storage for the energy dissipated in the surrounding atmosphere or as a source of energy which can directly offer a direct process of heating or of cooling.

Key words: drying, malt, geothermal water, primary/basic thermic agent.

INTRODUCTION

Food industry holds an important place in the goods consumption industry. Nowadays a special attention is given to the introduction of new techniques, of modern technological processes, of quality improvement and of malt obtaining processes.

The theory of malt drying mentions the fact that once the disintegration has reached the wished degree, the sprouting must be stopped by drying the green malt. The green malt contains 44-46% water and the dry malt has a content of 1.5 – 3% humidity immediately after the end of the drying process.

The removal of water through evaporation, meaning over 40% from the weight of green malt must be done with the help of the heat air drying installation. The type of the obtained malt greatly depends on the way the drying is performed. The drying process aims to stop the malt solubilization and germination and its aim is also to obtain the malt specific taste, flavor and color, according to the quality of the beer to which this malt shall be used.(Cojocaru C., T Predescu, E Roman, 1961)

Taste and flavor are the result of some reactions that take place between the components of the malt, especially between the disintegration products, at high temperatures. The main reaction is the combination of sugars with amino acids, resulting in the formation of melanoidin (or of melamine) aromatic and colorific products.

The flavor that forms at high temperatures does not depend only on these temperatures but it also greatly depends on the way the drying process

is performed. Since the malt has a high humidity at the beginning of the drying process, the enzymes form many disintegration products thus it is easy to obtain flavored and dark colored malt. In order to obtain blonde malt the drying process must be performed at lower temperatures (Cojocaru C., T Predescu, E Roman, 1961).

The high temperatures as well as the humidity content must be well controlled and used in order to avoid the destruction of the enzymes, being well known that enzymes are destroyed at high temperatures and that a sufficient quantity of enzymes is needed in the brewing process. The resistance power of enzymes depends not only on the temperature but also on the type of malt. The dryer the malt, the longer the enzymes last.

The malt must be sufficiently dry when the temperature increases so that the humidity content does not exceed 10% when the temperature reaches 50°C. Even for the brown malt, the final temperature of 105°C must not be exceeded in order not to destroy too many of the enzymes.

It is not recommended to increase the temperature in the malt that it is still wet because the starch gets gluey at a temperature of 60°C and hard-glassy malt is obtained after the drying process. As a consequence, this leads to a small extract of malt especially in the brewing process. (Cojocaru C., T Predescu, E Roman, 1961)

There are two steps in the drying process. The initial drying step in which the enzyme disintegration still continues and which can be considered as a continuation of the germination process and the proper malt drying during which there are only chemical and physical-chemical reactions between the malt components.

It is important to distinguish the two steps and to distinguish the way they function because the whole drying technique depends on this. In the case of blonde malt production the drying must be performed quickly at lower temperatures before the malt is brought to the proper drying temperature. For the brown malt the temperature of 45-50°C must be maintained for a longer time until a higher quantity of water is removed. A higher quantity of air at low temperature must pass through the malt in order to dry it; thus, the air stream for the blond malt is ensured by a ventilator. (Cojocaru C., T Predescu, E Roman, 1961)

The drying has got a decisive influence over the beer quality just like the germination and in the case of the brown malt the influence of drying is even more important. In order to obtain the characteristic type of malt, the specially controlled process and the heating one must be performed properly. The most appropriate type of barley must be searched for the drying process. For the brown malt it is recommended to use barley which is richer in protein substances, which are more easily soluble to obtain higher

quantities of amino acids and sugars in order to form melanoidin. (Cojocaru C., Predescu T., Roman E., 1961)

MATERIAL AND METHOD

The research was carried out in 2010 at S.C. Agrosem, Bihor County. The presented system uses, as a primary thermal agent, the geothermal water from a geothermal drilling (365 K, artesian flow10 l/s). The drilling has an electrically operated valve EV1. (Ionescu G., et all 1983, Wang H.G., 2009). A depth pump is installed in the well, a shaft type pump, placed at a depth of 90 m and it is started by a 65 kW electric engine (made by General Motor, USA), situated in the superior part of the shaft-pump assembly. (Danfoss 1986, Dionissios P. Margaris, et all 2006, Dorf R., C, 1998).

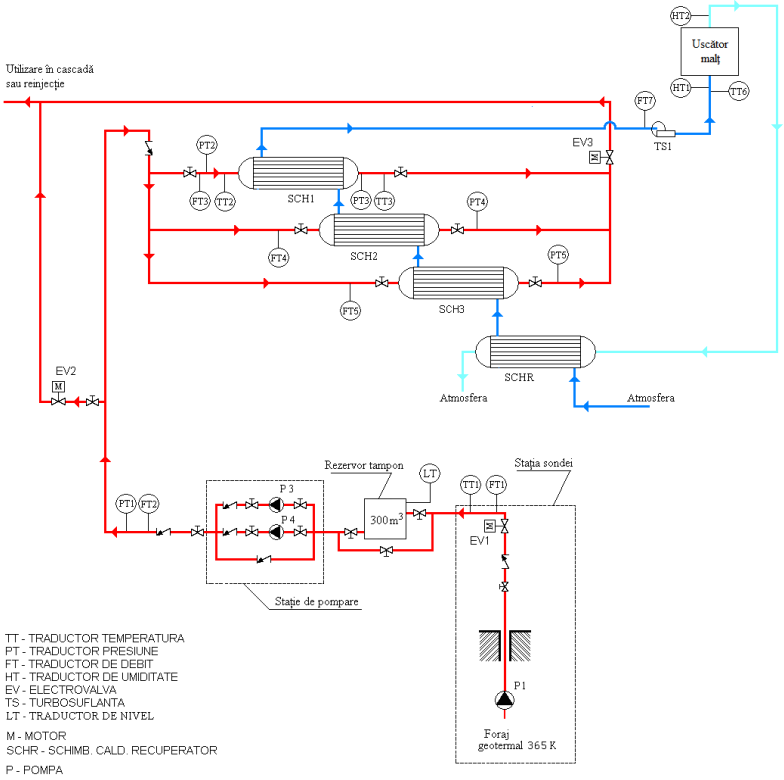
The system also contains: a buffer tank of 300 m³ placed near the well station; the tank has the role to de-gas and to standardize the way the system functions; the pump station placed near the well station has two Grundfos pumps and the necessary auxiliary equipments. (Anton I, 1979, Bofet E 1973, Curtis D.J. 1988). The role of the pump station is to provide geothermal water with the pressure and flow characteristics needed by the downstream equipments. (Tester J. W., B. J. Anderson, at all 2006, Lund John W, Derek H. Freeston 2000, Kailash N. Bhardwaj 2008, Kairouani L., Nehdi E. 2005). The system functions in an "artesian regime", in which case the well station distributes the geothermal water directly into the system of the main pipes; it also functions in a "pumping regime" situation in which the well station distributes the geothermal water to the near buffer tank and the pump station takes over the water from the tank and pumps it into the main pipe from which it is distributed to different consumers. (Kavak E. Akpinar, 2005, Zanoelo E.F., 2008,)

The secondary thermal agent is the atmosphere air. This air is dried in an air drying installation and it is pre-heated in the SCHR recuperator.

The drying of the malt takes place in grill installations, with the help of an air stream that passes through the malt layer. They are divided into three categories according to the position of the grills and their degree of load.

Vertical dryers are more often used because they take less space and they offer higher production. The grills of these dryers are placed vertically.

The green malt is introduced between two such grills placed at a distance of 20-25 cm one from another and the malt shall form a layer that has exactly this thickness. The distance between two neighboring rows of grills is of 60-80 cm, this space being used for the air circulation.



Drawing 1. The functional-constructive chart for the malt drying system

The dryer in drawing 1 (Iancu Carmen, 2010), on which experimental research has been done, is divided on two floors; here there are also two overlapped areas just like in the plane dryers. The overlapped vertical layers are split with the help of some clack-valves, so that the malt layer can be left from a superior floor to an inferior one. The whole drying installation is placed in a vertical building like a tower. The heated air mixes with the freshly cooled air and it is set in each drying area according to the temperature and to the humidity content (Villegas Javier A., Stephen R.Duncan et. all. 2009, Laurijssen Jobien, Frans J, 2010).

Air circulation is provided with the help of 10 ventilators. The heated air enters through the hole number 1 into warm air from room 2, then it passes through the malt layer situated between the vertical grills number 7 and from here it is evacuated through room 9 with the help of the ventilator that maintains the air stream.

In this way the management of the air is done gradually; the admission and the direction of air circulation can be closed simultaneously with the setting of a clack-valve row. (López A., A Esnoz., A Iguaz at all, 2007)

The germs remain mixed with the malt grains and they form more spongy layers, allowing the air stream to pass through more easily. Under each pair of vertical grills there is a helicoidal transporter which unloads the malt. The malt is brought from a superior floor to an inferior floor as follows: when the drying is over the clack-valves between the inferior and the middle floor are closed and the clack-valves situated above the transporter are opened.

The helicoidal transporter is turned on and the falling dry malt is transported further. The malt is loaded through the admission hole.

RESULTS AND DISSCUSIONS

In order to determine the geothermal energy consumption of the dryer we must take into account the heat quantity needed for the malt drying; this heat is made up from the heat necessary to warm the dry substance of the malt; from the temperature to which the malt is brought to so that I can dry, until the temperature to which it is unloaded; the heat necessary to discharge the water from the malt; the heat necessary to warm the machine; the heat losses; the supply of the heat losses due to the draft.

The highest quantity of humidity is eliminated in the dryer on the superior grill, at a temperature of 40-50°C. During the final drying cycle, meaning between a temperature of 75°C and 105°C, the temperature of the malt from the inferior grill increases. For this reason, the dryer functions with a higher quantity of air distributed in different areas in order to obtain the mixture of warm and cold air at the necessary temperature.

After the performed measurements it can be noticed that the balance of the total heat for 100 kg of malt, in the case of the used dryer, is the following:

Table 1

The heat balance in the malt drying

Operation	Brown malt	Blond malt
Heating of the malt	3,900kcal=2.9%	2,700kcal=1,5%
Humidity discharged	42,000kcal=29.7%	42,600kcal=29%
Air evacuated through the draught stack.	34,900 kcal = 24.5%	41,000 kcal = 28.5%
Radiation and cooling	17,400 kcal = 12.5%	17,400 kcal = 11.4%
Heat losses and air management	43,000 kcal = 30.4%	43,000 kcal = 29.6%

CONCLUSIONS

Only the air movement direction is changed for an even drying, an operation that can be easily performed by closing the air clack-valves which used to be opened and by opening those which used to be closed.

This operation is performed systematically 4 or 6 times a day. In this way there is no need to perform an action of turning the malt layer. The extra quantity of fresh cold air for the superior floors of the malt is done with the help of some pipes that communicate with the exterior atmosphere.

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