The kinetics of filtration drying of comminuted "energetic" willow

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Abstract – Drying is a complicated process of the heat-mass-exchange, which is widely used in the chemical industry as an intermediate or final stage of manufacture, on which effective organization the quality and the prime cost of a released product are dependent. More than 15% of the mined combustible is used for drying processes. Because of the usage of theoretically substantiated drying schedules and some obsolescent facility in the industry, they need in two and a half or three times more energy for the drying processes than for transforming of moisture to stream. It is known that Ukraine is an energy-dependent state and is able to satisfy only the minor part of its requirements, the another part is imported. That's why this scientific research is an acute problem and is directed to the analysing and diminishment of the energetic consumption during the production of alternative fuel.

The Key words: drying, energy-dependent, alternative fuel, energetic resource.

I. Introduction

One of the most high-intensity methods of drying is a filtration method, which is about filtrating of the warming agent through the stationary granular layer of the material. Such an organization of the drying process gives the opportunity to provide high coefficients of the heat-mass-exchange and, corresponding to this, a high intensity of the drying.

The intensity of the filtration drying of the comminuted "energetic" willow depends significantly on the heat quantity, which comes from the heat agent to the damp segment and is determined with the speed of the filtration of the heat agent, the difference between the temperatures of the cover of the hard part and the heat agent, and also the cover of the line-to-line contact.

The moisture in comminuted parts of the "energetic" willow is situated significantly inside and partially on the cover. During the drying the moisture evaporates because of adding of the heat; the propulsive force of this process is the difference between temperatures of the heat agent and the parts of a material.

II. The results of the experementary researches

These experementary researches were conducted on an experimental laboratorial facility. A layer of the comminuted "energetic" willow is marked by an irregular shape of its parts and severity of their external covers. The level of the covering of the parts of comminuted "energetic" willow is $K_п$ = 0,9, [1], and taking into account that the pore volume is rather big 0,802 $м^3/м^3$,we presumed that the heat agent washes the parts of a material on a ratable basis from all sides. The influences of the temperature t , the speed of the filtration of the heat agent ω_0 and the heigh of the material layer h on the kinetics of the filtration drying were researched. These experimental researches are pointed on the pictures (pic. 1 a, b, c) as the kinetic curve of the changes in moisture capacity w^c during the time τ, c .

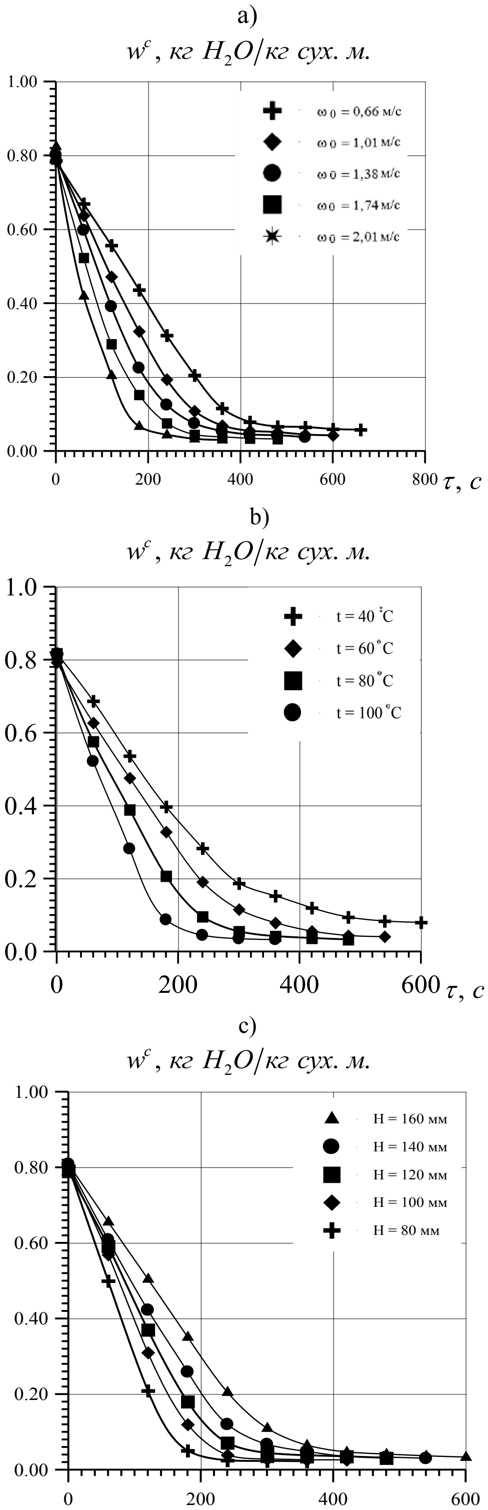

Fig. 1 a, b, c Kinetic curves of the kinetic of the filtration rying of the comminuted "energetic" willow at different parameters of the process

The primer moisture of the comminuted "energetic" willow is high and depends on many factors, as for example a season, the standing time after having been hacked down, the type of the ground, climatic enviroment or weather conditions etc. The main amount of moisture in a material is situated inside of the parts of communited "energetic" willow, only a small amount of them is situated on the cover of parts.. However, as we can see on the kinetical curves (pic. 1 a, b, c) we have the periods of constant and sinking speed of drying.

It is known that the filtration drying has the zonary character that we have shown in the 4th section. As a conclusion to our mechanism of filtration drying we observe the full saturation of the heat agent with the stream of moisture till the reaching of the limit of the mass-exchange of the perforated baffle plate, and on the kinetic curve we observe a straight line, which slope determines the speed of the movement of the mass-exchange zone. This stage of drying is called in the technical literature as a first conventional period of the filtration drying [2], but this name doesn’t show the physical a\sense of this process, because there are at the same time the dry material, the material, which the interior moisture evaporates from, and the material, which the exterior moisture evaporates from (in the direction of the heat agent). So, to show the physical sense of this process this stage of the filtration drying is rational to call the period of the full saturation of the heat agent.

After the limit of the mass-exchange reaches the perforated baffle plate the quantity of the damp material diminishes and the heat agent saturates with the stream of the moisture only partly. As a result of the measuring of the difference of the moisture capacity, which was conducted with the mass method, the difference of the moisture capacity diminishes exponential on the kinatic curves and approaches to balance. Analogically, as in the first case this stage would rationally be called the period of the fractional saturation of the heat agent and this name measures up the physical sense of the process of the filtration drying.

Analysing the picture 1a, it comes to the acknowledge that the increase of the speed of the heat agent can help to bring to the layer more heat, and according to this helps to evaporate more moisture. That is why the slope of the straight segment of the kinetic curves to abscisses increases with the increase of the speed of filtration.

The analogical situation happens in the case of the increase of the temperature (pic. 1 b) It is understandable that the increase of temperature leads to the growth of the drying potential of the heat agent and at the equal speed of filtration of the heat agent the increase of temperature leads also to diminishment of drying time. As we can see the tangent of the angle of kinetic curves in the straight segment increases with the growth of temperature.

The research of characteristic curve (pic. 1 c) shows that at the equal speed and temperature of the heat agent, that means at the equal drying potential the slope of the straight segment of the kinetic curves depends on the height of a layer and diminishes with its growth.

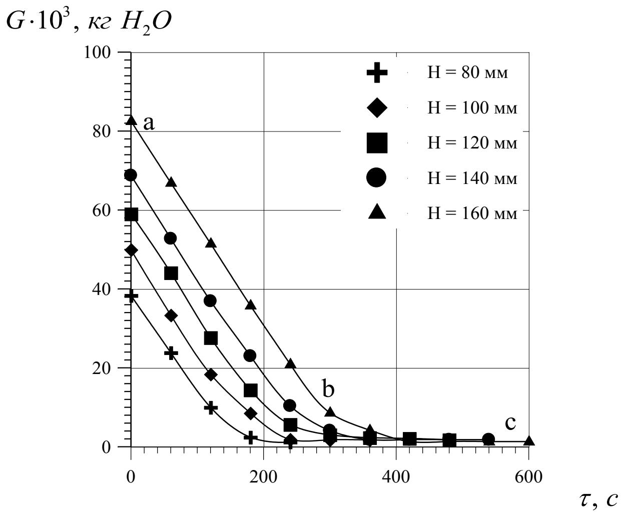

Fig. 2 The dynamic of the extraction of the moisture from the layer of comminuted “energetic” willow

To explain the reason of this phenomenon there is the dynamic of the extraction of moisture during the filtration drying on the picture 2 as a characteristic curve of the residual quantity of the moisture in the layer which depends on the parameters of the heigh of the layer. The research of the picture 2 shows that the quantity of moisture which is extracted by the heat agent from the layer doesn’t depend on the height of the layer, what the parallel alignment of the straight segments says for.

References

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