PRE-DRYING AND DRYING INSTALATION OF WOOD MATERIAL AND BERRIES

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Abstract
In industrial applications, geothermal energy provided by a geothermal fluid of up to 150°C is used in basic processes, such as: preheating, sterilisation, vaporisation, freezing, washing, drying, distillation, shucking, etc. Depending on the structure of the industrial process, geothermal energy may be used either independently or combined with other different energies.In this paper it is described a proposed constructive-functional design of a system of predrying and drying of the wood material and berries using geothermal water as heat agent.

Key words: drying installation, wood material; geothermal energy.

1. THE CONSTRUCTIVE-FUNCTIONAL SCHEME OF PRE-DRYING AND DRYING SYSTEM

The constructive-functional scheme for the pre-drying and drying system for wood material and berries, shown in Figure 1., includes: installation of pre-drying wood waste, installation of wood waste drying, installation of pre-drying berries, installation of drying berries.

Each installation is equipped with

- Heat exchanger (SC1 ÷ SC4), for the preparation of the agent for the pre-drying or drying installation that serves
- Circulation pumpsP1÷P4;
- Electrically operated valves, CV1 ÷ CV4 for the geothermal water circuit, respectively CV5 ÷ CV8 for the circuit of the agent for the pre-drying or drying installation that serves
- Temperature transducers TT1÷TT4, Tx1÷Tx4;
- Pumping system H1 ÷ H4 (equipped with compressors C1 ÷ C4 and pumps of completing P5 ÷ P8)

The presented system is using heat agent the geothermal water from a geothermal drilling (85°C artesian flow 30 l/s). It is provided with a pressure transducer TP1 and a electrically operated valve CV0.

In the probe it is installed a pump of depth, such as "axis", located at a depth of 90 m and is driven by a 65 kW electric motor (manufactured by General Motors, USA), located at the upper part of the assembly pump-shaft.

The system includes: a buffer tank, of 300m^3, located in the vicinity of the probe station, with a role in gassing and standardize the operation of the system, pumping station, located near the probe station, equipped with two Grundfos pumps and auxiliary equipment that is necessary.

The role of the pumping station is to supply geothermal water at flow and pressure characteristics necessary to the downstream equipment.

The system works both in “artesian regime”, in which case the probe station distributes geothermal water directly into the main distribution pipelines, and the “pumping regime”, in which case the probe station distributes geothermal water near the buffer tank and the pump station take water from the tank and a pump out in the main distribution pipe from where is distributed to different consumers.

2. TECHNOLOGICAL CALCULATION REQUIRED FOR THE SIZING OF THE PRE-DRYING INSTALLATION

2.1. Establishing the system of pre-drying and drying of wood material

A relatively accurate method to determine the duration of pre-drying, in days, is the one of the sum of the coefficients "S". This method allows the determination of the duration of pre-drying of the material which includes the initial heating period, final treatment and cooling of the material, based on the formula:

$$S= As+ Ag+ A1+ Ak+ Ac+ Au$$

The coefficient "As" is chosen from Table 2. depending on the wood species or on the products derived from this species.

Table 1 Indication on establishing the class of difficulty of the pre-drying system

	Difference	**Psychometric**	°C for	Stage of	humidity	
Class of difficulty	Below 10%	10-15%	15- 20%	20- 25%	25-30%	Over 30%
I	27	22	15	11	8	6
II	25	20	14	10	6	4
III	25	18	12	9	5	3
IV	25	16	11	7	4	2
V	20	14	10	6	4	2
VI	18	12	8	5	3	2

Table 2 The As coefficient values

Species	**Fir, Spruce**	**Pine, cedar, white poplar, aspen**	**Birch**	**Beech, larch**	**Oak**
As values	0	4	25	45	71

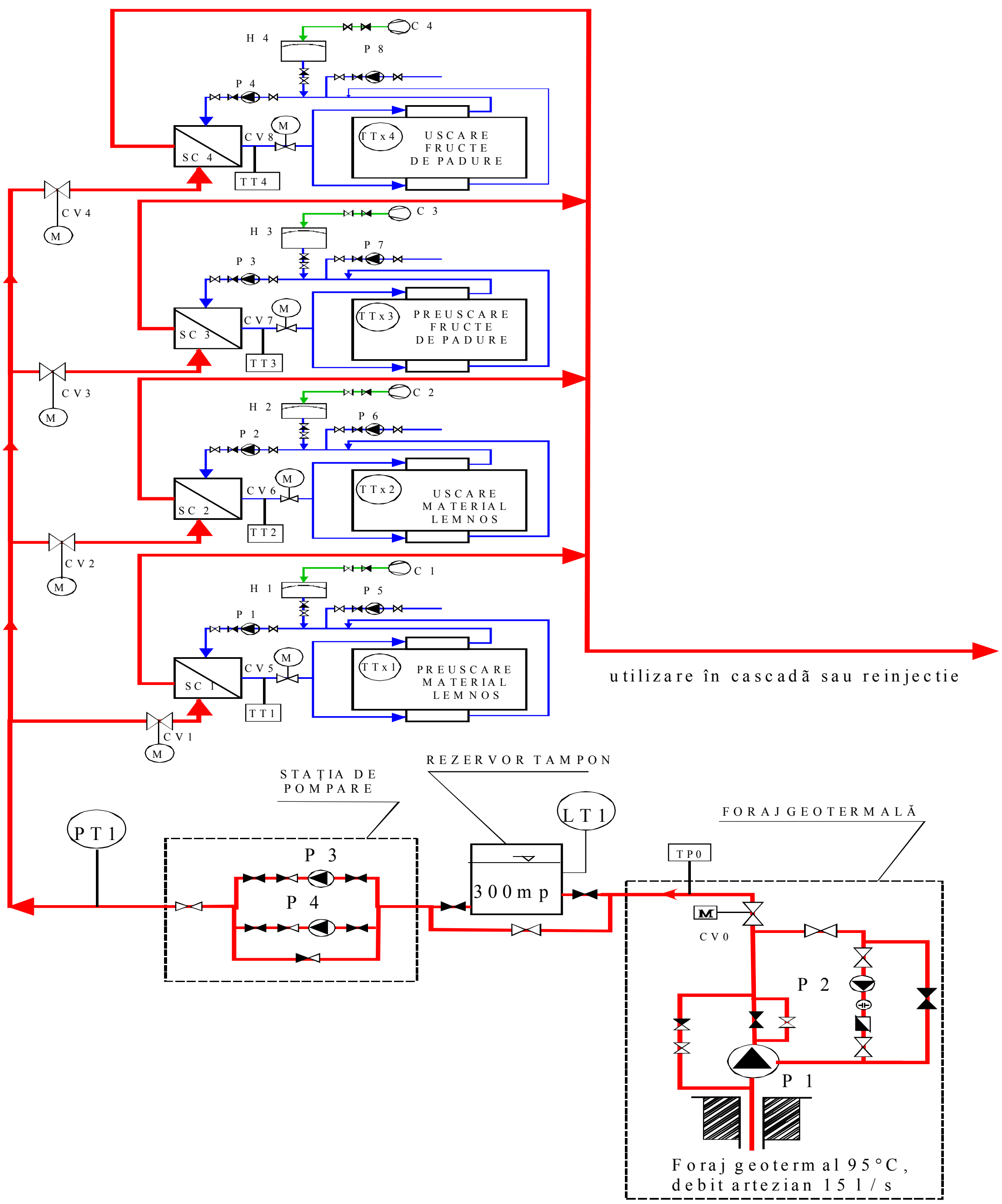

Fig. 1. The constructive-functional scheme for the pre-drying and drying system for wood material and berries

The Ag coefficient is chosen according to the material thickness or the layer of material submitted to pre-drying, in Table 3.

For different wood materials the value of Ag coefficients can reduce according to the coefficient of settlement or to their apparent specific weight

The coefficient A1 is chosen according to the relationship between the width and thickness of the material in Table 4.

The Ak coefficient is chosen depending on the quality of pre-drying taken from Table 4.1, parameter which is used for the entry in Table 5.

The Ac coefficient depends on the characteristics of the pre-drying chamber (Table 6).

The Au coefficient depends on the initial and final moisture of the material, the values of this coefficient are given in Table 7.

Table 3 The Ag coefficient values

Thickness mm	**Coefficient Ag**	**Thickness Mm**	**Coefficient Ag**	**Thickness mm**	**Coefficient Ag**
13	0	45	54	110	110
16	9	50	59	120	116
19	16	55	65	130	121
22	23	60	70	140	125
25	28	70	80	150	130
30	36	80	89	180	142
35	43	90	97	220	155
40	49	100	104	280	170

Table 4 The A1 coefficient values

Ratio of L/g	1,0-1,3	1,4-2,0	2,1-4,0	4,1-7,0	7,1-15,0
A1	0	5	9	14	18

T
able 5 The Ak coefficient values

Quality of the pre-drying	**VI-IV**	**III**	**II**	**I**
Ak	0	5	9	20

Table 6 The Ac coefficient values

Chamber with the high thermal capacity with cross - reversible circulation of the air	0
Chamber with the normal thermal capacity with cross - reversible circulation of the air	18
Chamber with natural circulation or low stimulated	27
Chamber heated from horizontal channels with natural circulation	33

Table 7 The Au coefficient values

Initial moisture	Final moisture											
	8	9	10	11	12	13	14	15	18	20	22	25
30	66	62	58	54	50	46	42	38	23	15	8	-
40	75	71	68	65	62	59	56	55	44	38	32	21
50	80	77	75	72	69	67	65	63	55	51	46	38
60	84	82	79	77	75	72	70	68	62	58	55	48
70	88	85	83	81	78	76	75	73	67	64	61	55
80	90	88	86	84	82	80	78	77	71	68	65	61
90	92	90	88	85	85	83	81	79	75	72	69	65
100	94	92	90	87	87	85	83	82	77	75	73	70

Drying regimes oriented after time offers a great convenience for the exploitation of the drying installations. In addition to the method presented at the setting of the drying regime it can be use the criteria of decrease of moisture or the criteria of determining the internal stresses in the material.

3. CONCLUSIONS

Although geothermal energy is categorised in international energy tables amongst the "new renewables", it is not a new energy source at all. People in many parts of the world have used hot springs since the dawn of civilization. Geothermal energy is independent of weather conditions, contrary to solar, wind, or hydro applications. It has an inherent storage capability and can be used both for base-load and peak power plants.

REFERENCES

[1]. **Astrom K.J., Wittenmark B.** (1984): *Computer Controlled Systems. Theory and Design*, Prentice Hall, 1984.

[2]. **Astrom K. J**., Control System Design, Lund Institute of Technology, 2002.

[3]. **Bojörnsson, J., Fridleifsson,I.B., Hhelgason, Th., Jonatansson, J:M., Palmason. G., Stefansson,V., and Thorsteinsson, L.** (1998).*The potential role of geothermal energy and hydro power in the world energy scenario in year 2020*. Proceedings of the 17th WEC Congress, Huston, Texas.

[4]. **Carabogdan, I.Ghe. ş.a.** (1986): *Manualul inginerului termotehnician*, Editura Tehnică, Bucureşti, 1986.

[5]. **Gabor G.** (1996): *Considerations Regarding Programable Logical Controllers*, Proceedings of ECI'96, Kosice-Herlany, 1996.

[6]. **Ghezzi C., Jazayeri M., Mandrioli D.** (1991): *Fundamentals of Software Engineering*, Prentice Hall, 1991.

[7]. **Goble W.M.** (1992): *Evaluating Control Systems Reliability – Techniques and Appplications*, Instrument Society of America, 1992.

[8]. **Larionescu S.**, Aspecte moderne în proiectarea inginereasca a sistemelor automate, A XXXVII-a Conferința naționala de instalații, Sinaia, 1-4 oct., 2002, p.5-18.

[9]. **Setel Aurel** *Cercetări Privind Posibilitățile De Extindere A Instalațiilor De Uscare A Lemnului La Conurile De Roşinoase* Comunicare științifică la sesiunea de comunicării științifice a UNIVERSITĂȚII DIN ORADEA Mai 2001