

Technology redoing of wood in the gaseous fuel

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For today are known quite a bit methods of redoing of wood and its wastes in energy, but one of the most perspective is gasification. Due to large potential, small terms of recoupment of projects, wood is ecological advantages most priority among other renewable energy sources in the most world countries.

The construction of the gazogene, on which the row of experiments is conducted with the aim of determination of conformity to law of influence of entrance factors which influence on the process of gasification and on quality of synthesis-gas, was worked out for this purpose. The statistical processing of experimental data enables to define the optimal parameters of work of gazogene.

We have constructed a mathematical model of the gasification of wood wastes in gazogene with a continuous layer. The search of optimal decision is conducted, id est being of such values of factors within the limits of range their changes at which an initial parameter arrives at a maximum on the basis of equalization of regression. Model allows to get the detailed information about quality of synthesis-gas depending on entrance factors which influence on the process of gasification. Substantial reduction of considerable money and resources which are spent at the receipt of necessary information from realization of experimental researches is possible.

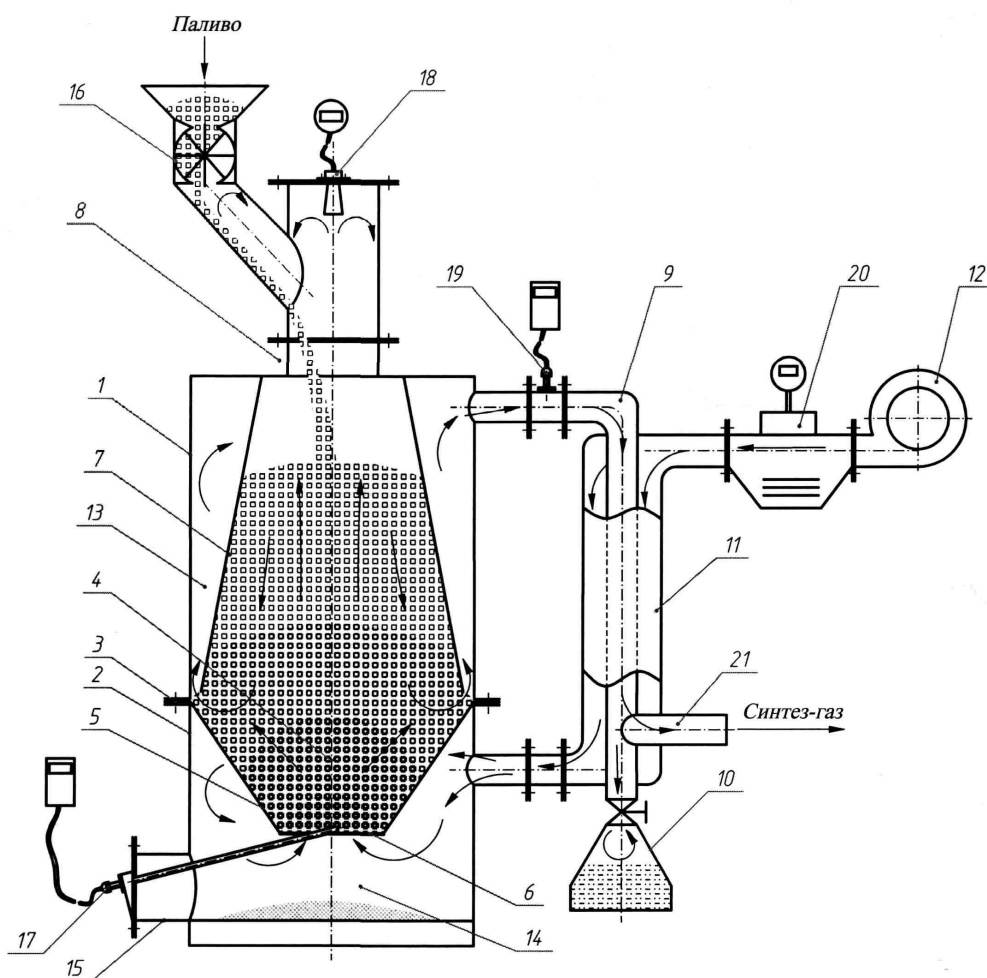
In many countries of the world biomass, as a source of making of energy today gets more ponderable value in the different sectors of economic activity, in particular: on the thermal and electric stations for the production of warmth and electric energy. It is related first of all to exhausting of extractive block which results in the increase of price on them fuels. Except it an extractive fuel has a large influence on the state of environment, and it compelled world public to creation and introduction in an action of the program of the Kyoto agreement. It is necessary to notice that potential of

biomass to ten one times exceeds possible requirements of humanity in energy, is ecologically clean and has a capacity for renewal.

Today the tendency of decentralization of energy takes place in the world, id est there is the use of cogeneration plant making of heat and electricity. Perspective cogeneration plant are engines of internal combustion, which work on the eider of synthesis gas.

Therefore gasification of wood with the aim of making of synthesis gas is the most perspective and ecological method of redoing of biomass.

In the National University of Forest Technology of Ukraine. the construction of gazogene is worked out with the continuous layer (picture.1.) on which a patent is got (Patent of Ukraine "Gazogene" [of a.c. Ukraine №38952, МКП C10J 3/00, it is printed 26.01.2009p.].) Taking into account new designer developments the experimental setting of gazogene is built.



Picture .1. A structural chart of the laboratory gas-producing setting is with a continuous layer.

Corps - 1,2; screw-bolt connection - 3; chamber of gasification - 4; bottom cone - 5; furnace-bar grate - 6; overhead cone - 7; hatch - 8; pipe for taking of synthesis gas - 9; tank for the condensated matters - 10, casing for cooling of gas of synthesis - 11; supercharger of air - 12; intercone space - 13; device for an ash - 14; hatch for moving away of ash and lighting of fuel - 15; sluice breech-block - 16; thermocouple - 17; radar microwave device for measuring of level - 18; thermocouple - 19; device for measuring of expense of air - 20; union coupling for taking of synthesis gas to the consumer - 21.

The gazogene works as follows. In the chamber of pyrolysis 4 (Picture.1) a fuel (ground up wastes of wood, and other) is loaded through opening 8. Gasification of fuel takes place by his decay at the insufficient amount of oxygen for burning. For providing of process of gasification of fuel air-blasted through a furnace-bar grate 6 in the chamber of pyrolysis a 4. Synthesis-gas which appears in the process of gasification sent in intercone space 13, and it goes out through the union coupling in overhead part of gazogene and moves on a pipe 9, which is in casing 11, on which air acts in bottom intercone space 14. Such construction of pipe allows to heat air which is forced in the chamber of pyrolysis and simultaneously to cool synthesis-gas. In the underbody of corps gazogene 2 device for an ash is foreseen 14 with a hatch 15 for moving away of ash lighting of fuel by means of torch.

Originality of construction is that the chamber of pyrolysis is executed as two cones greater bases of which are placed to meet friend to the friend, that eliminates hanging up of fuel and his bearing-out in the union coupling in overhead part of gazogene; device for the serve of oxidant-air, from a supercharger, executed with casing into which the set pipe for taking of gas of synthesis from overhead part of corps to the consumer and for weathering of the condensated matters, that allows to heat air which is forced in the chamber of pyrolysis, and cool synthesis-gas; the corps are connected by screw-bolts, that provides simplicity in service.

As a fuel the ground up wood, sawdusts, is used, vegetable biomass and other, gasification of which takes place in the chamber of pyrolysis, which is executed as the symmetric placed зрізаних cones, and which are placed apeak and symmetric in a corps by greater bases to each other. In the underbody of internal cone a furnace-bar

grate through which acts an oxidant is air. A fuel acts through overhead part of gazogene. Thus, the process of gasification passes more intensively due to even distribution and the best interfusion of the ground up wastes, not accumulating on a furnace-bar grate. Getting through the layer of fuel, synthesis-gas sent in intercone space and goes out through the union coupling in overhead part of gazogene and given to the consumer.

The use of gazogenes of the offered construction will allow підвищити efficiency of work by the increase of speed and intensity of gasification of wastes of wood and to work out the problems of industrial and domestic wastes, receipt of cheap energy and ecological state of environment. In fact, during a purveyance and processing of wood appears near 20-25% wastes from a general volume, in the forest-park area of 60-70%, used wood as a result of repair of building of 10-12%. Traditionally these wastes gather and burned, or taken out on dumps. Calorie content of these wastes hesitates within the limits of 8-18 MJ/kg.

In the process of realization of experimental researches wood of different breeds was used: willow (*Salix of alba of L.*) by humidity of 41%, pine-tree (*Pinus of sylvestris*) by humidity of 43%, birch (*Betula of pendula of Roth.*) by humidity of 40%, the particles of which preliminary cut an identical thickness, breadthways and by corresponding lengths of l.

Variable entrance x_i factors of experimental researches of process gasification of wood :

- sizes of factions of wood l : 10, 20, 30, 40, 50 mm;
- it is an amount of air, which is given in the gazogene G : 40, 65, 90 nm^3/hour ;
- it is an amount of wood in a gazogene from the general volume q : 50, 75, 100 %.

Initial parameter of y :

- more subzero warmth of combustion of synthesis gas, MJ/m^3 .

The basic task of experimental researches is determination of conformities to law of influence of entrance factors of work of gazogene on quality of synthesis gas. A task consists in being of dependence of more subzero warmth of combustion of gas of synthesis from a breed, sizes of the ground up wood which is given in a gazogene, amounts of air and and amounts of fuel from the general volume of reactor.

Without regard to that data of every experience yielded preliminary to statistical treatment with the aim of searching for of flagrant errors.

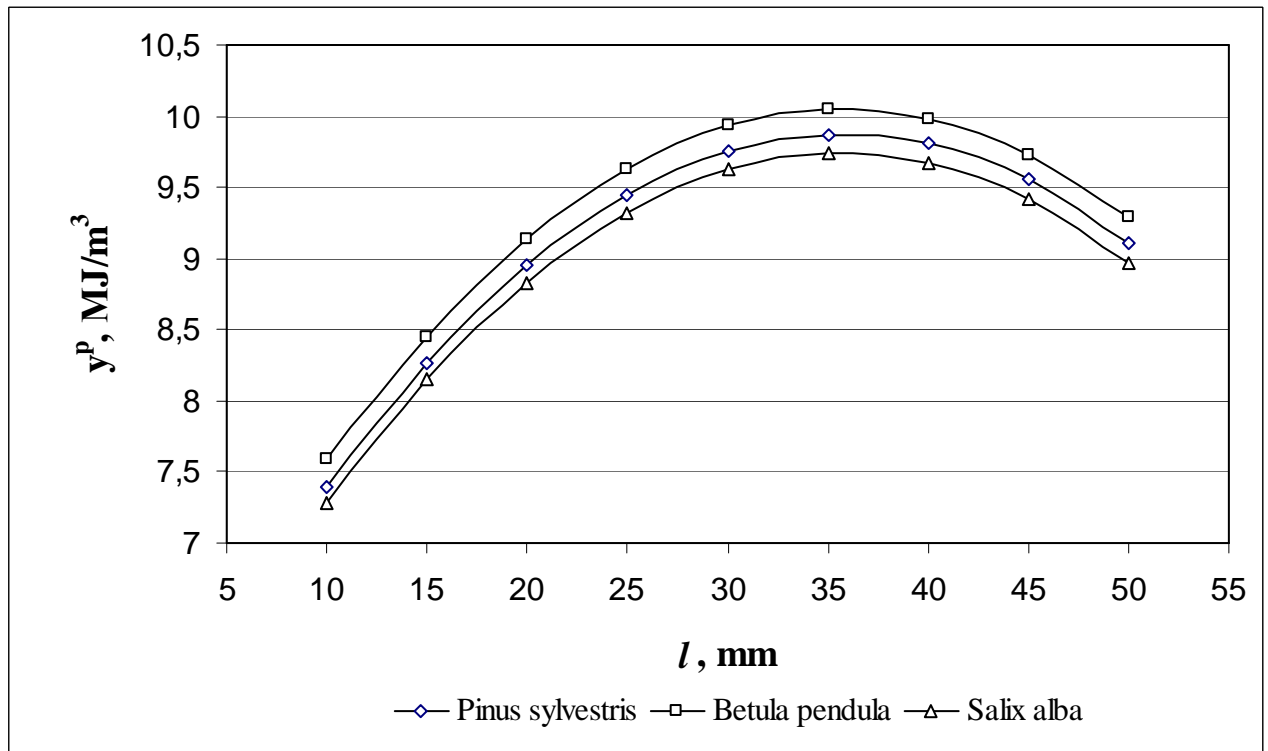
In a table.1. some these experimental works over of gazogene are brought on pine wood by a size a 30 mm.

Table 1

№	Amount of air, nm^3/hour	An amount of fuel is in a gazogene, %	Qcep, MJ/m^3	A temperature is on a furnace-bar grate, $^{\circ}\text{C}$	Temperature to gas of synthesis on an exit from gazogene, $^{\circ}\text{C}$	Composition of gas of synthesis, %					
						H_2	CO	CO_2	CH_4	N_2	O_2
1	40	50	8,403	1193	124	10,98	27,72	7,87	4,43	48,75	0,25
2	40	75	8,995	1211	117	10,95	27,75	7,82	4,48	48,87	0,13
3	40	100	8,695	1202	108	10,82	27,88	7,78	4,52	48,78	0,22
4	65	50	9,289	1213	127	11,66	28,14	8,25	5,75	45,82	0,38
5	65	75	9,875	1219	118	11,58	28,22	8,27	5,73	45,96	0,24
6	65	100	9,636	1215	101	11,61	28,19	8,23	5,77	45,99	0,21
7	90	50	8,810	1223	131	10,18	29,32	8,57	5,23	46,52	0,18
8	90	75	9,430	1236	122	10,29	29,21	8,52	5,17	46,54	0,27
9	90	100	9,185	1231	117	10,13	29,37	8,65	5,15	46,42	0,28

Realization of the program of development of methods of mathematical design of processes of the thermo-chemical processing of wood assists the increase of ecological indexes of processes, reduction of lead-times of asms, modernisation of existent engineering methods of calculation and planning of equipment, search of optimal operating of vehicles and rational ways of the use of fuels conditions.

After the got equalizations of regression dependence (y^p) of more subzero warmth of combustion of synthesis gas is certain, from the sizes of wood ($l = 10, 15, 20, 25, 30, 35, 40, 45, 50$) at the mean optimal values of amount of air ($G_{\text{opt.}} = 70\text{nm}^3/\text{hour}$) and amount of wood in the reactor of gazogene ($q_{\text{opt.}} = 80\%$.) for the different breeds of wood.



Picture.2. Dependence (y^p) of more subzero warmth of combustion of synthesis gas, certain after equalization regression, from the sizes of wood (l) at the mean optimal values of amount of air ($G_{opt.}=70\text{m}^3/\text{hours}$) and amount of wood in the reactor of gazogene ($q_{opt.}=80\%$.) for the different breeds of wood.

Conclusions

1. The got mathematical model can be basis for optimization of the investigated process or rational management by him.
2. Having equalization of dependence of entrance factors from an initial parameter, it is possible to forecast all possible values of parameter of estimation of the investigated process at any values of factors which are between top and bottom levels.

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