Technical-Economic Justification Of The Efficiency Of Using The Heliopyrolisis Device In Heliothermic Processing Of Biomass

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ABSTRACT

This article presents in order to evaluate the effectiveness of the parabolic solar concentrator heliopyrolysis device developed, the indicators of natural gas consumption for domestic needs of households and consumers located far from energy supply (farmers and farms) were analyzed. Using a heliopyrolysis device with a parabolic solar concentrator, an average of 300÷350 m³ of gaseous fuel, 350÷400 kg of liquid pyrolysis fuel and 200÷300 kg of solid fuel per year for household needs of residents and consumers located far from the energy supply the availability of alternative fuels is scientifically based.

Keywords: Solar energy, parabolic concentrator, material balance, biomass pyrolysis, alternative fuel, solar pyrolysis plant.

Introduction

Natural gas consumption per capita in Uzbekistan is 3 times higher than in developed countries and neighboring countries. For comparison, in foreign countries, 90 m³ of gas per person per year is needed, while in Uzbekistan, this figure exceeds 400 m³. According to statistics, in 2018, 3,2 mln. more households than 10 billion m³ of gas were consumed in (14 mln. inhabitants). And this one the apartment year during heating and household needs for 5000 m³ gas is used means in the country of Belarus this indicator 1700-1900 m³ organize reaches [1-3].

Kashkadarya region opposite in the city built exemplary of houses heat and electricity supply system energetic analysis that's it shows that heating, hot water supply and electricity in supply traditional energy resources saving, stable respectively energy (heat and electricity energy) with to provide, especially heat in supply traditional (natural gas, coal, firewood and etc.) fuels share and ecological effect reduce such as problems. There is this in apartments household needs for expendable common gas spending per day maximum 4,5 m³ in case organize reaches [4-8].

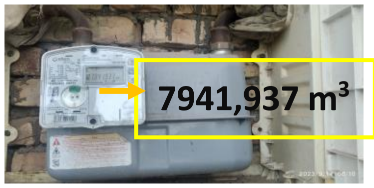
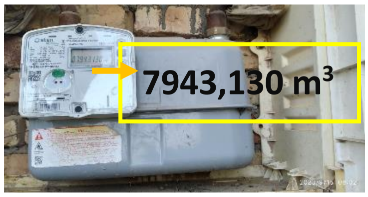
Urban planning norms and according to the rules (ShNQ) (2.04.08-13 "Gas supply. Project norms") of gas accounting spending gas supply has been in the apartment gas plate when and centralized. Hot water supply and gaseous water space heater otherwise per 1 person per year $\bar{G}^{y}_{gas} = 6000 \frac{MJ}{year}$. Is as a result, 3 persons of the household household needs for 3x600 per year =18000 MJ/year, 614 kg conditional fuel or 490-500 m³ up to natural gas consumption does [9].

Exemplary houses and energy from supply away is located of consumers (farmer and farmer farms) household goods (food preparation , tea boiling, hot water and etc.) in natural gas supply traditional and again renewable , in particular the sun energy based on working devices work exit and parameters justification important task is [10-14]. This task scientific based on without solve and it is considered an urgent task.

Method

In order to evaluate the effectiveness of the heliopyrolysis device with a parabolic solar concentrator developed in the article, the natural gas consumption indicators for domestic needs of households and consumers located far from the energy supply (farmers and farms) were analyzed (table 1).

Table 1
Indicators of natural gas consumption for household needs in households

Gas plate type	Parameters	Consumer type (144 m² heating to the surface have waxy house)	Household needs for average gas consumption
 Artel Apetito 10-G	Oven volume: 65.0 l The work systems number: 2.0 Electric energy source: 220 V/50 Hz Stoves number: 4.0 Without packaging Dimensions (WxDxH): 850x600x600 Packaged Dimensions (WxDxH): 930x650x700 Without packaging weight :41.0 kg Packaged weight: 45.0 kg	 	I. Experimental results  09/14/2023 at 8:00 am  09/15/2023 at 8:00 am Daily real gas consumption**:** **0,95 ÷ 1,1** m³/day .
 Artel Milagro 50 02-K Combined plate	Oven volume: 52.8 l Electric energy source: 220 V/50 Hz Upper TEN power: 1000.0 W Stoves number: 3.0 Electric comforters number: 1.0 Without packaging dimensions (ExChxB): 500x570x850 Packaged dimensions (ExChxB): 555x665x900 Without packaging weight:31.7 kg		II. " Hududgaztaminot" JSC statistician information : Opposite in the city subscribers Number: **65,000** Household needs for average gas consumption: **54,000 – 60,000** m³/day Daily average gas consumption: **0,83 – 0,92** m³

 Artel Apetito 00-G Gaz plate	Oven volume: 65.0 l The work systems number: 2.0l Stoves Number: 4.0 Without packaging Dimensions (WxDxH): 850x600x600 Packaged Dimensions (WxDxH): 930x650x700 Without packaging weight: 36.0 kg Packaged weight: 40.0 kg		III. Sample (144 m^2 heating surface) of the house natural gas costs (actual need): Daily : **0.95-1** m^3 Monthly : **28.5-30** m^3 Year : **340-360** m^3

The amount of gaseous fuels (pyrogas) released from biomass and organic waste V_{PG}, m^3 , is determined using the following expression:

$$V_{PG} = n_s \cdot m_b \cdot g_{ek} \tag{1}$$

here, n_s –daily number of downloads, $n_s = 3$; m_b –product mass loaded into the reactor, kg; g_{ek} –The amount of pyrogas released from 1 kg of biomass or organic waste, g_{eq} = 0,3÷0,45 m/kg (experimental results).

The amount of pyrogas released from biomass and organic waste per month is determined as follows in the sunny months of the year:

$$V_{PG}^{mon} = 30 \cdot V_{PG} \tag{2}$$

The reactor of the heliopyrolysis device is cylindrical, and its dimensions are mainly determined by the ratio of its height to its internal diameter (h/d = 0.9...1.3). If we assume that h/d = 1, then the following equation is formed:

$$V_r = \frac{\pi d_r^2}{4} \cdot h = \frac{\pi d_r^2}{4} \cdot d_r$$

$$d = \sqrt[3]{\frac{4V_b}{\pi}} = \sqrt[3]{\frac{4 \cdot 1,3}{3,14}} = 0,2\ m \tag{3}$$

The amount of heat used to heat the biomass or organic waste to the pyrolysis process Q_{heat}, MJ, is determined as follows:

$$Q_{heat} = c_b \cdot m_b \cdot (t_{pyr} - t_{ext}) \tag{4}$$

here, c_b –heat capacity of biomass or organic waste , $\frac{J}{kg \cdot {}^\circ C}$; t_{pyr} –temperature of the pyrolysis process (350÷500 ^oC); t_{ext} –external temperature, ^oC.

The average monthly amount of heat used to heat biomass or organic waste is determined as follows:

$$Q_{heat}^{mon} = Q_{heat} \cdot \tau_{day.mon} \tag{5}$$

Here, $\tau_{day.mon}$ –monthly number of sunny days.

Side walls of the reactor to be lost heat quantity Q_{lost}, MJ, q in the house from the formula defined as:

$$Q_{lost} = k \cdot F_{reak} \cdot (t_{pyr}(\tau) - t_{ext}) \tag{6}$$

this on the ground , k –the heat transfer coefficient, $\frac{Vt}{m^2 \cdot {}^\circ C}$; F_{reak} –the surface of the side of the reactor, m^2; monthly t_{ext} –average of the external environment temperature,°C; $d\tau$ – pyrolysis process time, sec.

Heliopyrolysis device reactor for heat transmission coefficient the following equation using is:

$$k = \frac{1}{\frac{1}{\alpha_n} + \frac{\delta_r}{\lambda_r} + \frac{1}{\alpha_k}}, \frac{Vt}{m^2 \cdot {}^\circ C} \tag{7}$$

this on the ground α_n –light heat transfer to give coefficient ,$\frac{Vt}{m^2 \cdot ℃}$; α_k- convective heat transfer to give coefficient ,$\frac{Vt}{m^2 \cdot ℃}$; of δ_r –reactor material thickness, m; λ_r –reactor material heat permeability coefficient ,$\frac{Vt}{m \cdot ℃}$.

Monthly amount of heat lost from $Q_{lost}^{mon}$the reactor , MJ, determined from the following formula:

$$Q_{lost}^{mon} = Q_{lost} \cdot \tau_{day.mon} \quad (8)$$

Pyrolysis process for demand to be done common energy quantity as follows defined as:

$$Q_{dem} = Q_{heat}^{mon} + Q_{lost}^{mon}, MJ/month \quad (9)$$

Results and discussion

Above from expressions used without calculated the results are presented in table 2.

Table 2.

Months in the section work issued gaseous amount of fuel (pyrogas).

Months	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
t_{ext}, ℃	6.3	9.2	16.4	22.6	28.7	33.1	38.9	36.8	30.5	20.6	13.3	8.1
$\tau_{day.mon}$	10	9	11	13	22	30	31	31	30	27	15	15
Q_{heat}, MJ/ month	71.6	64.4	78.7	93.0	157.4	214.7	221.8	221.8	214.7	193.2	107.3	107.3
Q_{lost}, MJ/ month	25.0	22.5	27.5	32.5	54.9	74.9	77.4	77.4	74.9	67.4	37.5	37.5
$Q_{sp.y,}^{x}$ MJ/mon	96.5	86.9	106.2	125.5	212.4	289.6	299.2	299.2	289.6	260.6	144.8	144.8
V_{PG}^{mon}, m^3 /mont	13.5	12,15	14.85	17.55	29.7	40.5	41,85 _	41.85	40.5	36.45	20.25	20.25

Experience to the results according to parabolic the sun concentrator heliopyrolysis on the device months in the section work issued liquid and char (active coal) fuel amounts are in tables 3 and 4.

Table 3.

Months in the section work issued liquid biofuel quantity

Months	1	2	3	4	5	6	7	8	9	10	11	12
Rubber waste, kg	6.6	5.4	6.6	8.4	13.8	18	18.6	18.6	18	16.8	9	9
Poultry manure, kg	3.3	2.7	3.3	4.2	6.9	9	9.3	9.3	9	8.4	4.5	4.5
Polyethylene film, kg	18.5	14.85	18.5	23.1	37.95	49.5	51.15	51.15	49.5	46.2	24.7	24.7
Plastic bottle, kg	10.8	8.9	10.8	13.8	22.7	29.7	30.6	30.6	29.7	27.7	14.8	14.8
Plant waste (cotton stalk), kg	8.5	7.02	8.5	10.9	17.9	23.4	24.1	24.1	23.4	21.8	11.7	11.7

Table 4

Months in the section work issued char fuel quantity

Months	1	2	3	4	5	6	7	8	9	10	11	12
Rubber waste, kg	14.8	12.1	14.8	18.9	31.1	40.5	41.8	40.5	40.5	37.8	20.2	20.2
Poultry manure, kg	11.2	9.1	11.2	14.2	23.4	30.6	31.6	31.6	30.6	28.6	15.3	15.3
Coal	13.2	10.8	13.2	16.8	27.6	36	36	37.2	36	33.6	18	18
Plastic bottle, kg	8.9	7.2	8.9	11.3	18.6	24.3	25.1	25.1	24.3	22.8	12.1	12.1
Plant waste (cotton stalk) , kg	12.2	10.2	12.3	15.6	24.1	31.6	32.6	32.6	31.6	29.3	16.1	16.4

Conclusion

So is done research and count results that's it shows that the offer done the sun concentrator heliopyrolysis device using one up to 3 kg per day raw material again worked. Kashkadarya in the region in the area yearly sunny 300 days that acceptance if we do, one in minimum 300x3=900 kg raw the item again work can. So, this one device using one 900÷1000 kg of biomass per year or organic waste heliothermic again work opportunity is created. As a result parabolic the solar concentrator heliopyrolysis device using per year for household needs of consumers located in households and far from energy supply on average 300÷350 m^3 gaseous fuel, 350÷400 kg liquid pyrolysis fuel heat and 200÷300 kg up to char alternative fuel get possible was determined .

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