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BIOMASS STANDARDIZATION AS A BASE FOR ITS SUFFICIENT USE

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Summary. The article provides technical and economic characteristic of terms and methods that ensure higher economic and ecological sufficiency of usage of different types of local fuel on the grounds of biomass. It also determines the proficiency of fuel gasification on the grounds of biomasses for power that allows creating terms for their complex standardization.

Key words: biomass, standardization, gasification, gas-generator.

INTRODUCTION

There are three Laws adopted in the field of renewable energy in Ukraine, 42 National Standards are approved, seven National Programs are on. Biomass is the fourth world significant fuel covering 1250 mln. of tons of equivalent fuel totaling 15 % of primary sources in the world (up to 45 % in developing countries). According to the forecasts of World Energy Council [1] the part of biomass will total from 350 to 800 mln. of tons of equivalent fuel, or 42-46% of total excavating fuels until 2020 p. This proves the formation of powerful world market of fuel biomass.

Energy Equipment that works on the biofuel has certain requirements to fuel, the adhering of which determines it energy sufficiency, durability and technical and economic indexes. That is why the main issue on the Ukrainian energy resources market is to provide status of standardized energy resource to biomass.

OBJECTS AND PROBLEMS

Vegetable wastes are various according the nature structure and technological waste structure in the end of processing or processing primary raw material. As a result we have different physical and chemical peculiarities of wastes for fuel that depend on the terms of growth, processing technology, climate and soil. However, the most important characteristics from the point of view of usage of them as energy resources (combustion heat of unit, chemical composition) are very close [2].

The classification of vegetable wastes according to its form and size of fuel part allows not only to research the diversity of wastes in Ukraine it is also useful for studying their characteristics and for choosing preparation technology and usage.

The base of the suggested classification of vegetable waste (seven classes are reviewed) is their main biological feature that determines natural form of plant or the one that we get as a result of gathering and primary processing. The classification of solid biofuels starts with determining origin which can be subdivided into following groups: biofuels on the base of wooden wastes, biofuels on the base of grass wastes, biofuels on the base of secondary biomass. The characteristics of classes of vegetable wastes were determined by the next physical features: stem, grain of two size classes, leaf, and characteristics of wooden waste – by the solidity of wood species.

Each class affiliates with subclasses that combine wastes with more individual structure peculiarities, and, finally, the subgroup is subdivided into separate groups of vegetable wastes groups with sole physical characteristics.

Additional opportunity of classification of vegetable fuel is according to its improvement. Not-improved fuel is the one when produced the raw material is not chapped or packed with any change of mechanic peculiarities. Such type of fuel includes traditional wood, chock, chips, pressed wooden wastes, wood processing wastes (saws, chips). Accordingly, the improved include fuels the mechanical peculiarities change in the preparation stage (for instance, pellets or cakes).

Wooden fuel biomass is subdivided into the one from forest trees, energetic trees and secondary use (disposed wastes).

Fuel biomass is represented by the varity of physical forms that specify the diversity of it processing to fuel technologies [3].

The chemical composition of biomass (represented in dry, ash-free condition) more finished by its composition than in other solid fuels. The main characteristics of fuel that specify the possibility and appropriateness of its gasification are: mechanical possibility, ash content, composition of organic mass, heat production. The heat production can be determined for the dry-and-ash-free fuel on operational fuel. The heat production of dry-and-ash-free fuel is determined by the amount of heat that is released by the dry-and-ash-free components. Besides them, the duel contains metal – mineral mixtures (ash) and water that decrease heat productivity of fuel when combusting it. The heating effect when combusting or gasification of 1 kg of fuel is determined by the composition of dry-and-ash-free mass and the amount of metal in fuel, in other words by the composition of operating fuel.

The quality estimation of gas generated fuel according to high level of heat production on dry-and-ash-free mass (Q_v^g) does not give anything distorting its quality. Instead we should use low heat production of operating fuel (Q_n^p) that migh total up to 50% of Q_v^g .

The less metal the fuel contains the better fuel characteristics and higher caloricity.

Formula $\frac{Q_n^p}{Q_v^g}$ (operation heat production of fuel coefficient) inverted proportionally to content of metal in fuel — ash and moisture:

$$\eta_p^m = \frac{Q_n^p}{Q_v^g} \cdot 100\%. \quad (1)$$

This coefficient allows giving total estimation of fuel quality according to its heat production in metal content. The decrease of metal content in fuel increases its quality that is why it is a significant qualification feature.

In order to create reasonable terms for carrying out gasification process the fuel shall have certain minimal moisture content. The decrease of moisture to below set one might affect gasification process and quality of generated gas. It is important to define best definition of η_p^m, which might serve as general criteria for different types of solid fuels. Furthermore, different sources consider different meaning of biomass moisture. Thereby some scientists estimate moisture according to the factual biomass weight (2), others according to their dry weight (3).

$$MCW = \frac{M - C}{M}, \quad (2)$$

$$MCW = \frac{M - C}{C}, \quad (3)$$

where: M is factual weight; C is dry weight.

On the grounds of gasification practice and theoretical generalization in this field we know [7] that the best content of weight W^p and minimum possible content of ash A^p for different types of fuel that varies within figures stated in table 1. Those values define the best level η_p^m for different typrs of fuel.

Comparing the obtained values η_p^m with the fuel characteristics in the view of their gasification it is easy to determine their correspondence.

The calculation give the opportunity to divide the listed above fuels according to their heat production qualities into four groups (table 2).

The estimation of fuels by their heat production cannot be limited by the stated above calculations. We should define the fuel consumption in kilograms and Joule per 1 kW of output power. When researching we obtained data for different types of fuel and equipment of different power, the equivalents of solid fuels to petroleum – standardized fuel that can serve as ethanol.

In order to estimate the quality of fuels when using them in gas generating installments of transport type it is important to know the amount of heat which is released by the volume unit of fuel (for instance, 1 l or 1 м^3), because the amount of fuel that can be processed in gas generator is define by the volume of tank, while the calculation set forth the loaded fuel mass.

Table 1. **The best content of moisture and minimally possible content of ash for different types of fuel**

Type of gas generated fuel	Content, %		Best value, η_p^m
	A^p	W^p	
1	2	3	4
Birch chops	0,7	18	71,0
Birch coal	0,9	10	89,0
Top peat	4,0	30	59,5
Peat briquettes	5,0	15	78,4
Peat charred coal	6,0	8	84,1
Brown coal	5,0	18	57,9
Blind coal	3,0	6	82,1
Semi charred coal	4,0	8	86,2
Wooden coal briquettes	2,0	6	90,0
Briquettes from agriculture wastes	5,0	12	76,5
Soft species pellets	0,5	10	83,8
Solid species pellets	0,4	8	84,3

Table 2. **The classification of fuels by their heat production characteristics**

Fuel Group	Value η_p^m	Fuel Quality
1	2	3
I	More than 90	Excellent
II	From 85 to 90	High
III	From 80 to 85	Good
IV	From 65 to 80	Satisfactory
V	Less than 65	Undervalued

Therefore the heat production of fuel shall be defined by:

$$\frac{Q_k \cdot q}{1000} = Q_l, \qquad (4)$$

where: Q_k — is heat production of 1 kg of fuel, Joule,

q — volumetric (loading) weight of 1 м^3 fuel,

Q_l — heat production 1 l of fuel, Joule.

The correlation of $\frac{Q_l}{Q_k}$ gives the value of unit density of fuel that can be expressed through the coefficient of heat density *i*:

$$i = \frac{Q_l}{Q_k} \cdot 100. \tag{5}$$

This coefficient allows estimating heat production of fuel including such significant index as a loading weight. The fuel characteristics give comparative estimation by the most important index – heat production including ash content, moisture and volumetric weight.

However, the decisive indexes of fuel quality used fir gas generating installments is the quality of generating gas, amount of gas that we ibtain from unit volume of fuel, heat production. Those indexes varies for different types of fuels depending on their content. The content of metal in fuel chops the heat of its burning, as a result of correspondent decrease of amount of dry-and-ash-free mass. That is why, the fuels with the constant content of dry-and-ash-free mass and with little of ash content, the burning heat is defined by the moisture content. Except carbon and hydrogen the dry-and-ash-free mass contains nitrogen gas and oxygen. Each percent of nitrogen gas decrease heat when burning up to 1 %. The amount of nitrogen gas in dry-and-ash-free mass is miserable (less than 1 %) therefore it affects a little on heat burning of fuel biomass.

Each percent of chemically connected oxygen that contains in dry-and-ash-free mass additionally decreases burning heat up to 110 kJ/kg.

In order to conduct comparative estimation of fuels we need to consider physical and chemical features necessary for ensuring perseverance of gasification process. They include: 1) reactivity; 2) volatile matters content; 3) the nature of charred coal remains; 4) mechanical strength; 5) lightness of gasification; 6) transportability.

There is no final index of gasification index and solidly of solid fuel on the grounds of biomass. It is very difficult to obtain due to the amount of factors that define this index. In order to ease classification and unification of fuels we need to implement index in the form of scale of using easiness of fuel for gasification in gas generating installments. The project of classification in gas generating fuels by their sufficiency to use is represented in table 3. This peculiarity is better to standardize.

It is clear that each solid fuel requires special terms regarding to the construction of gas generator. The experience of different types of solid duels showed that they can be divided into five big groups that define the choice of gas generator construction. The unification of construction of gas generator that based on standardization of output gas generating fuels, simplifies the issue of their use and manufacture, which, in its turn allows decreasing their price. The possibility of gasification of various types of fuels in generator of one type extends the use in different regions of Ukraine.

Table 3. **The classification of gas generating fuels by the sufficiency to use**

Class of use for gasification	Description	Type of fuel
1	2	3
I	No difficulty. Can be used without preparative operations. Possibility of automated fuel feeding.	Wooden pellets.
II	No difficulty. Can be used with preparative operations.	Wooden coal (when correlation to its sizes of technical requirements), wooden briquettes.
III	Previous fuel processing is necessary (drying, chopping).	Wooden chops, wooden coal.
IV	Upfront selection, processing or enrichment of fuel is necessary and also additional work when operating gas generator (clearing ash-bin, stoking fuel, etc.).	Peat, peat briquette, brown coal, semi charred coal of coal, peat coal.
V	The use of fuel is possible only after complicated processing (briquetting, thermal processing, etc.) or special selection of species. When operating there might be difficulties to ensure normal work of gas generating installment.	Brown coal and peat with increased ash content, coal (increased quality), anthracite, coal. Straw in briquettes.
VI	Using fuel within Trading and Tariffs Agreement by physical and chemical peculiarities is difficult and not reasonable economic wise.	Coal.

CONCLUSIONS

The combination of experiment and theory is natural for gasification in transport gas generators in contemporary machinery building field. This is conditioned by the deficit of technical information and research results. Due to these facts we provided the extended analysis of perspective of standardization of solid fuels on the base of biomass in order to substitute excavating fuels is of significant value.

The adoption of standards for biofuel will create conditions for setting market of fuel biomass, the need for which initiates creation of energetic plantations in woodless regions of Ukraine, creating of which has a significant social and economic aspect – will give an opportunity to open labor vacancies and increase the living level of people.

The standardized energy resource status will create conditions for vigorous development of energy market in Ukraine and ensure stable characteristics of equipment that works on fuel biomass.

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СТАНДАРТИЗАЦИЯ БИОМАССЫ, КАК ОСНОВА ЕЕ ЭФФЕКТИВНОГО ИСПОЛЬЗОВАНИЯ

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Аннотация. В статье представлена технико-экономическая характеристика условий и методов, обеспечивающих наивысшую экономико-экологическую эффективность использования различных видов местного топлива на основе биомассы. Определяется рентабельность использования твердых топлив на основе биомассы в силовых целях, что создает предпосылки для их комплексной стандартизации.

Ключевые слова: биомасса, стандартизация, газификация, газогенератор.