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TECHNOLOGY OF BIOENERGY OBTAINING FROM COTTON STEM HUMS IN THE CONDITIONS OF UZBEKISTAN

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Annotation

The article focuses on the technology of obtaining biogas from cotton stalk humus, one of the sources of renewable raw materials, using agricultural waste. In the article, the possibility of using biomass from agricultural plant humus, the chemical composition of biomass, the conditions of its formation in the environment, as well as the development of new technologies for obtaining biogas, the procedures for their use, and the improvement of the ecological conditions of the environment are discussed in the article. It is thought that it can be achieved.

Key words: biomass, biogas, bioreactor, substrate, anaerobic, extract, thermophiles mode, methane tank.

Аннотация

В статье рассмотрена технология получения биогаза из перегноя стеблей хлопка, который является одним из источников возобновляемого сырья, с использованием отходов сельского хозяйства. Кроме того изучены возможности использования биомассы из перегноя сельскохозяйственных растений, химический состав биомассы, условия ее образования в окружающей среде, а также разработка новых технологий получения биогаза, способы их использования и совершенствования и экологического состояния окружающей среды.

Ключевые слова: биомасса, биогаз, биореактор, субстрат, анаэроб, экстракт, термофильный режим, метантенк.

Agricultural waste represents a huge source of biomass. Plant and animal wastes make up the Earth's biomass, an important type of fuel that accounts for a large amount of available energy. Agricultural waste mainly includes cultivated crop residues such as wheat and rice straw and husks, hemp and cellulose-rich wild plants, straw, cattle manure, waste and surplus products. For the first time, in 1985, 110 million tons of manure and crop residues were used as fuel in India. In the same years, the amount of agricultural waste in China increased by 2.2 times the amount of wood fuel. Every year, millions of tons of straw are harvested all over the world. But with a thousand regrets, it can be said that every year more than half of the cultivated straw is not used. In many countries, biomass equivalent to this gold is left in the field and burned or buried. For the same reason, in many developed countries, the environmental protection organization has banned the burning of biomass in the fields. These prohibitions caused biomass to be considered as an energy source.

The use of crop residues for energy purposes raises the following question: what amount can be used without a negative impact on the yield. According to the qualifications of developed countries, it is possible to lose about 35% of crop surpluses without affecting the future harvest. Industrial waste, which constitutes biomass, can also be used for energy production. For example, combustible gas can be obtained from the residues of alcohol production. Other types of useful waste include feed and textile industry waste. Returning to the above points, it is possible to obtain high-quality energy from agricultural waste. For the same reason, scientists have developed various methods of obtaining energy from waste, and one of them, and the most effective, is biogas.

1-tab.

Biogas obtained when using different raw materials and its methane content

Raw material type	***Amount of gas obtained m^3 per kilogram of substance***	***Content of methane, %***
	Household waste	
Sewage, garbage	0,310-0,740	70
Vegetable waste	0,330-0.500	50-70
Potato stalk	0,280-0,490	60-75
Beet stalk	0,400-0,500	85
	Dry waste of plants - stubble	
Wheat straw	0,200-0,300	50-60
Rye straw	0,200-0,300	59
Barley straw	0,250-0,300	59
Oat straw	0,290-0,310	59
Corn straw Flax straw	0,380-0,460	59
Flax straw	0,360	59
Beetroot	0,165	
Sunflower leaves	0,300	59

Alfalfa	0,430-0.490	
Others		
Grass is grass	0,280-0,630	70
Leaves of trees	0,210-0,290	58

As mentioned, this process of production of biogas and fertilizers is carried out in special bioreactors - methane tanks.

Biodegradation of organic raw materials in bioreactors can be carried out in the following three different temperature regimes and periods:

1. Psychrophilic mode at a temperature of 5-250C for 30-40 or more days;
2. Mesospheric regime at a temperature of 25-37 0C for 12-20 days;
3. Thermophile regime at a temperature of 49-60 °C for 5-12 days. In the psychrophilic regime, the fermentation of biomass occurs very slowly

- in almost two months, which means that gas production is low and the quality of the obtained fertilizer is also very low.

Most biogas plants operate in the mesospheric temperature regime. The thermophiles temperature regime is mainly used for centralized processing of raw materials in large biogas plants.

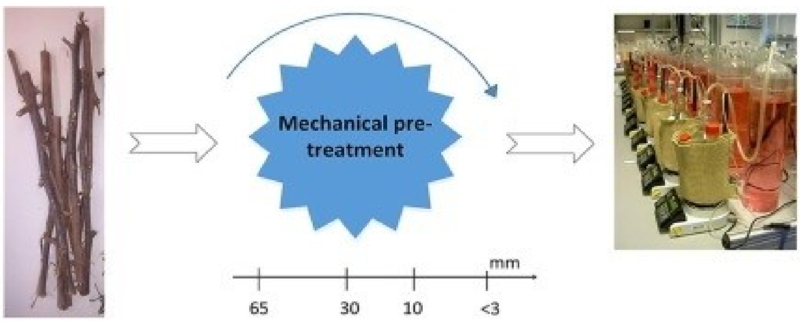
The method of placing the substrate in the bioreactor can be continuous or periodic. In a periodic method, a certain amount of plant straw is added to fresh manure mixed with water, and it is put into a bioreactor. The substrate is left in the open air to increase its temperature within a day or two. In the next two or three days, it ferments under anaerobic conditions and biogas production begins. After 10-14 days, productivity reaches the highest level. Then gas production begins to decrease and after some time it reaches about half of the maximum production level.

Another method of batching is to combine fermentation and storage systems. In this case, one reservoir serves as both a bioreactor and a collector. The reservoir is gradually filled with straw manure, depending on the speed of raw material fermentation. The advantage of this system is its low cost. It should be noted that a certain amount of heat can be lost and an unstable gas can be formed during the processing of plant waste manure in this way.

Currently, the technology of obtaining biogas from cotton stalks for renewable energy sources is widely studied and scientific research is being carried out. In this regard, the use of agricultural waste as a source of biomass allows to save energy, which is expensive for production. For example, the stalks of cotton, an agricultural product left in the field after harvesting cotton, are a source of natural fuel. But it has little economic value. Currently, most of the stalks are removed from the fields, buried or burned in the field to prevent the pest from multiplying in the future. However, this huge amount of by-product from cotton production is a potential source of income. Recent studies show that high levels of Cl, K, and Na in stalks reduce ash solubility during combustion and cause corrosion and fouling problems. Therefore, it is preferable to use it as a source of clean energy. Thus, cotton stalks are not a suitable raw material for direct combustion. Instead, its use for biomethane production is proposed as a promising, cost-effective technology. In this case, it is advisable to pre-clean cotton stalks to increase methane production.

The cotton stalk is brought to the state of granules with small particle sizes from 0.5 to 65 mm. These pellets are made anaerobically at 37°C for 48 days. It was shown that methane output is inversely proportional to particle size and the quality of biogas is good (54.0-55.2% CH4).

A significant increase in the methanogens phenomenon is observed with 20.3% and 26% for substrate with particle size of 3 mm and 0.5 mm, respectively, compared to untreated cotton stalks. The coefficient of anaerobic energy turnover is relatively low (20.2-25.5%). To achieve efficient methane conversion and reduce the storage time of the anaerobic event from 31 to 25 days, it is possible to reduce the particle size of cotton stalks to 3 mm or less. However, in order to cover the high energy demand required for small granulation, size reduction should be combined with chemical and physic-chemical pretreatment. Before obtaining biogas from cotton stalks, it needs to be treated to improve its biodegradability. A number of pre-treatment methods, including physical, chemical, physic-chemical and mechanical treatment, are necessary to improve the anaerobic digestion of raw materials. Although untreated biomass has a complex physical and chemical structure, reducing its volume allows effective improvement of microbial decomposition in the anaerobic process.



Cotton stalk Size reduction Anaerobic process

1-Figure. Substrate preparation and loading from cotton stalk waste

Pretreatment methods improve the degradation phenomenon of biomaterial.

This leads to higher efficiency. On the other hand, excessive reduction of the size of biomaterial can also lead to a decrease in biogas efficiency. This is due to excessive production of volatile fatty acids in the anaerobic process.

The size reduction of natural dried biomaterial of cotton stalk up to 100 mm long and 4.8% moisture content shows the effect on methane efficiency. For this, the biomaterial is cut to an average length of about 65 mm using an MC-22 hammer mill. Then some of them are made into granule stalks with particle sizes of 0.5, 3, 10 and 30 mm.

In the anaerobic event, the content of cotton stalks is taken into account: dry matter, organic matter in dry matter, crude protein, crude fiber, starch, crude oil, nitrogen-free extract and total nitrogen in organic matter. In this case, we will be able to use the analysis carried out by the micro analytical laboratory of the University of Vienna, Austria, and by comparing the experimental analyzes conducted in the conditions of Uzbekistan, we will be able to study the chemical analysis and composition. The composition and results of chemical analyzes are presented in Table 2.

2-tab.

Composition and elemental analysis of cotton stem.

Characteristics	**Basis**	**Material**	
		Cotton stalks	**Upload**
Dry matter	FM (%)	95.2	2.2
Volatile solids	DM (%)	91.6	52.8
Total nitrogen	FM (%)	0,88	ND
Ammonium is nitrogen	FM (%)	0,18	ND
Crude oil	DM (%)	0,7	0,8
Crude protein	DM (%)	6	14.5
Raw fiber	DM (%)	45.7	10
Nitrogen free extracts	DM (%)	43.9	27.5
Starch	DM (%)	1.25	ND
Sugar	DM (%)	4.3	ND
C	VS (%)	55.8	27.7
H	VS (%)	6.4	ND
N	VS (%)	0,95	6.3
S	VS (%)	0,06	ND

Characteristics	Basis	Material	
		Cotton stalks	Upload
O	VS (%)	36.8	ND
PH		ND	7.5
C/N		58.7	4.4

DM = dry matter; FM = new substances; ND = nonspecific substance; VS = volatile solids.

The accumulated biogas and methane efficiency of untreated cotton stalks for 48 days of mechanically pretreated cotton stalks is 211 and 113.9, respectively. After pretreatment, the biogas and methane output is inversely proportional to the particle size of the samples. A much higher biogas production is achieved between 221 and 260 ratio of refined biomaterial.

The increase in biogas and methane yield for different cotton stalk particle sizes compared to the untreated substrate is based on the following. This corresponds to 4.7-23.2% of untreated cotton stalks. The highest biogas production is achieved for biomaterial with 0.5 mm. When the volume of biomaterial decreases by 30, 10, 3 and 0.5 mm, respectively, the amount of biogas is significantly ($p < 0.05$) 11.8%, 12.8%, 18.5% and 23.2% increases to

Significant difference between methane release from pre-treated and untreated samples ($p < 0.05$); Av. = Average; % equals the share of methane in biogas.

The table below shows that the quality of biogas obtained from treated and untreated cotton stalks was satisfactory and ranged from 54.0% to 55.2%. The highest concentration of methane is obtained at a particle size of 0.5 mm. Biomaterial with particle size greater than 10 mm with the lowest methane concentration is obtained in the anaerobic process (Table 3).

3-tab.

Biogas and methane derivatives of cotton stalks for anaerobic process.

Particle size of CS samples [mm]	Biogas output kg	Methane output kg	
	Av.	Av.	%
0,5	260 ± 14,4	143,5 ± 9,4	55.2
3	250 ± 8,67	137,0 ± 6,4	54.8
10	238 ± 8,22	129,0 ± 6,0	54.2

Particle size of CS samples [mm]	Biogas output kg	Methane output kg	
	Av.	Av.	%
65	236 ± 8,12	127,4 ± 6,8	54,0
	221 ± 7,65	119,3 ± 5,6	54,0
Untreated	211 ± 15,7	113,9 ± 6,0	54,0

This showed that reducing the particle size to 10 mm and above resulted in a slight increase in methane concentration from 0.7% to 2%. This increase is probably related to the change in the structure of the substrate, which increases the availability of biodegradable organic matter under anaerobic conditions. In this case, obtaining biogas from cotton stalks can be integrated into the field, preventing cotton stalks from burning or preventing the remaining part of the cotton stalks from serving as a wintering place for insects. Mechanical pretreatment of cotton stalks for methane production shows potential for more efficient conversion of cotton stalks to energy. Because for biomaterial with a particle size of 3 and 0.5 mm, there is a significant increase in methane productivity by 20.3% and 26%, respectively. Compared to untreated biomaterial, the quality of biogas is good (54% CH 4) and slightly increases with particle size below 10 mm (0.7-2%). In order to create an anaerobic process of crushing cotton stalks, it is required to reduce the storage period in the units to 25 days instead of 31 days for uncrushed cotton stalks. However, since the turnover ratio of the anaerobic process is not high and ranges from 20.2% to 25.5%, it is necessary to optimize the pretreatment conditions to maximize methane production from cotton stalks.

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