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Straw briquette as an energy source

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Abstract: *Straw briquette as an energy source* The paper presents essential information on straw briquettes, it describes straw as an energy material, and the briquette combustion process. Environmental aspects of straw briquette combustion are analysed as well, along with the comparison of straw briquette with traditional sources of energy.

*Keywords***:** briquette, straw, renewable sources of energy, biomass

INTRODUCTION

The growing demand on energy is now accompanied by diminishing natural resources used by the power sector (coal, natural gas, crude oil). The prices of energy are soaring higher and higher, which makes renewable energy sources at the centre of attention. Renewable energy offers some obvious advantages: it is environmentally-friendly and non-exhaustible. These advantages make the renewable energy distinct from the traditional energy sources, which are the main culprit of the alarming climate change. Global fossil fuel resources will be exhausted sooner or later. It is estimated that coal resources will last for another 220 years, whereas the resources of natural gas and crude oil will be exhausted in 60 and 30-40 years, respectively. Facing the scarcity of fossil fuels and the environmental impact of the traditional energy sources, people are now looking for other ways to generate energy. Biomass combustion is one of alternatives, in which energy is produced of organic biodegradable substance made of agricultural, forestry and industrial by-products and waste materials. Straw briquette is one of biomass types which can be used to generate renewable energy.

General specification of straw as a source of energy

Straw is a by-product made of ripe or dry stalks of cereal plants, and also of dry leguminous plants, flax and rape. Like wood, straw is composed of cellulose, hemicellulose and lignin. In the past and today, straw is an agricultural by-product which has been mainly used for livestock bedding. The volume of straw produced has been on the increase with the introduction of modern agricultural production methods. As a result, new applications have been identified for the excessive amounts of straw produced in the agriculture, with energy production being one of them. The calorific value of dry straw is approx. 16.1-17.4 MJ/kg. As compared to coal (calorific value of approx 18.8-30 MJ/kg), 1.5 ton of straw briquette corresponds to 1 ton of medium-quality coal. Straw is neutral for the environment, and its combustion in power plants has no impact on CO_2 emissions: the same amounts of CO_2 are produced in straw briquette combustion and in photosynthesis.

Combustion of straw briquettes

The combustion of straw briquettes as a substitute to coal offers significant reduction in CO_2 emissions. It is estimated that the same amounts of CO_2 are produced in straw briquette combustion and in the plant growth process (photosynthesis). Another advantage is the significant reduction of sulphur compound emissions. However, increased emissions of nitrogen compounds can be an issue, exhaust gas can also contain carbon monoxide (CO), polyaromatic hydrocarbons (PAH) and hydrogen chloride (HCL). These emissions are

directly dependant on the straw combustion process, which is essential in the effective utilization of briquettes in energy production. Sufficient air needs to be supplied to the straw combustion furnace to reduce dioxin emissions to the minimum levels. Dioxins are considered very dangerous for environment, and it is therefore essential to safeguard the proper combustion conditions. Like the combustion of any other fuels, briquette combustion can be complete or incomplete. Complete straw combustion needs to be accompanied by the supply of specific volume of air. In case of air deficiency, soot and non-combusted gases are produced containing pitch vapours. On the other hand, the same by-products are produced in conditions of excessive air supply, along with ashes and dust. As a rule, 25-50% air excess is supplied to the boilers to guarantee better combustion performance. Briquette is a universal fuel. It can be combusted in low-power boilers with manual and automatic feed, as well as in automated boiler rooms with computer-controlled combustion. It is also eligible for use in gasifying boilers. Briquette can be combusted alone or can be co-fired with other fuels, such as coal. Apart from the biomass parameters, another factor is the ash produced in the combustion process. Ash from straw briquettes can be used as a mineral fertilizer, however, the combusted biomass must be free from any impurities and additives.

Straw vs. other fuels

Table 1. Straw vs. other fuels (Chochowski, 2001)

Parameters	Unit	Yellow straw	Grey straw	Coal	Gas	Wooden chips
Humidity	% by weight	15	15	12	0	40
Ash content	% by weight	4	3	12	0	0.6-1.5
Carbon content	% by weight	42	43	59	75	50
Oxygen content	% by weight	37	38	7.3	0.9	43
Hydrogen content	% by weight	5	5.2	3.5	24	6
Chlorine content	% by weight	0.75	0.2	0.08	-	0.02
Nitrogen content	% by weight	0.35	0.41	1	0.9	0.3
Sulphur content	% by weight	0.16	0.13	0.8	0	0.05
Volatile matter	% by weight	70	73	25	100	70
Calorific value	MJ/kg	14.4	15	25	48	10.4
Heat of combustion	MJ/kg	18.2	18.7	32	48	19.4

Summary

Non-renewable sources of energy will be gradually depleted, and the prices of traditional energy will be increasing. Biomass processing will become the mainstream. Straw combustion can be an important source of renewable energy. Straw briquettes are simple to make, no additives are typically required. Straw is processed with the use of briquetting machines: briquette presses, worm-type briquetting machines, and hydraulic ones, depending on the expected briquette parameters and the volume of straw processed. Moreover, the straw needs to have specific parameters, most notably humidity (up to 20%). Biomass combustion has a neutral environmental impact, and will contribute to preventing greenhouse effect and climate change in the long-term perspective. However, biomass as an energy source offers so much more than just reduced CO_2 and SO_2 emissions. Straw used for energy production can also contribute to the multifunctional development of rural areas. Small briquette plants will deliver inexpensive and environmentally friendly fuel to the local residents, and will create

more jobs. The production of straw briquettes as a renewable source of energy can be co-founded and supported by EU, which makes the establishment of professional production facilities of straw briquettes so much easier.

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Streszczenie: „*Brykiet ze słomy jako źródło energii*”. Praca zawiera informacje dotyczące brykietów ze słomy. Scharakteryzowana została w niej słoma, jako materiał energetyczny, ponadto w pracy opisano proces spalania brykietów. Poruszone zostały ekologiczne aspekty spalania brykietów ze słomy, a także porównanie ich z konwencjonalnymi źródłami energii.

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