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Abstract:

We provide turnkey solutions to making cotton stalk into biomass pellets. The cotton stalk making process including crushing, pelletizing, cooling and packing. The interest in using biomass residue pellets for heating purposes in creasing, especially cotton stalk pellet which is receiving consideration as a potential energy source because of its properties as fuel.

### Make Cotton Stalk into Fuel Pellets

## **1. Feasibility of Making Cotton Stalk Pellets**

In the world, cotton accounts for nearly 40% of global fiber production. High cotton production is accompanied by generation of tons of cotton waste each year. Development of economical and efficient methods for utilizing or disposing of cotton waste can be used as biomass fuel like cotton stalk pellets.

Depending upon the variety and the crop conditions, the stalks are 0.8 to 1.5 meters long and their diameter just above the ground may vary from 1 to 2.5 cm. The specific weight of short chopped stick is about 160kg/m<sup>3</sup>. The calorific value of cotton stalks is equivalent to poor quality wood. Heating value ( or calorific value) is essentially a material for burning a fire or as a thermal source of energy.

### **1.1 Abundant Raw Material**

Approximately 80 countries worldwide produce cotton, the U.S., China, and India together provide over half the world's cotton. Other major producers are Uzbekistan, Pakistan, Brazil, Turkey, Australia, Turkmenistan, Greece, Syria and Egypt.

Due to its large agricultural sector, Uzbekistan has an enormous potential of biomass energy generation. Main source of biomass in the country is cotton stalk. The annual out of cotton stalk is about 3 million tons, it deserves more attention for efficient use in energy generation. Almost all of this cotton stalk resource is consumed for cooking and space heating in the rural area by using the most conservative combustion process.

Cotton production is an important economic factor in the United States as the country leads worldwide in cotton exportation. All most all the cotton fiber growth and production occurs in southern and western states. More than 99 percent of the cotton grown in the US is of the Upland variety. The final estimate of U.S. Cotton production in 2012 was 17.31 million bales.

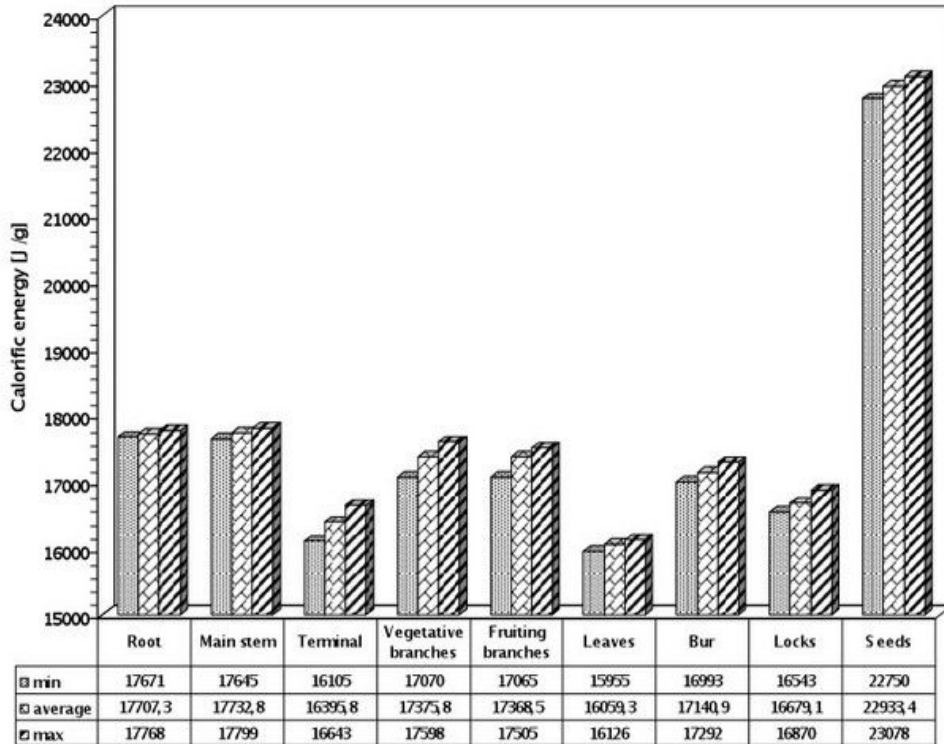
These two countries contribute a lot to the amount of cotton stalk residues.

### **1.2 Cotton Stalk Properties**

A number of properties are commonly known to affect the success of pelleting, including: heating value, moisture content of the material, density of the material.

#### **High Heating Value**

In terms of heating value, heating value ( or calorific value) is essentially a material for burning as fire or as a thermal source of energy. There is a calorific energy analysis in cotton plants could be helpful in developing highly applicable and productive planning for energy policies. The results shows that the calorific energy in different organs of cotton is different. The lowest calorific energy value in all plant organs was observed at leaves(15.955 KJ/g), while seeds contains the highest energy value varied between 22.750-23.078KJ/g. The calorific values of dry cotton stalks are varying from 15.861 to 15.100 KJ/g. Compared with other crop residues, the calorific energy of wheat straw, rice straw, corn stalk, soybean stalk are 17.98, 17.12-18.68, 15.40-18.25, 21.81-23.01 KJ//g, respectively. Therefore, cotton stalk can be used as pellet fuel in the respect of heating value.



### Low Moisture Content of Cotton Stalk

Water is one of the most useful agent that are used both as a binder and lubricant. Therefore water is particularly necessary as an aid in pelletizing. Several investigations of different materials indicate that the strength and density of pellet increase with increasing moisture until an optimal level is reached. The optimal moisture content for agricultural residues to be pelletized ranges between 8-15%. Cotton stalk moisture content is in this range. The stalks are left on the field, thus losing about 80% of their moisture in about 5 days. That means the stalk moisture content reaches the recommended range in a time period of less than one week. This implies that cotton stalks can be pelletized one week after the harvest operation is finished without incurring any additional cost for drying.

### High Bulk Density

Bulk density is the ratio between the weight of the pellets and the amount of space they take up. It reflects the amount of solid material packed into the pellet and therefore has a relationship to the heat content of the fuel. Lower bulk density may result in lower conversion efficiency, as it gives rise to poor mixing characteristics and nonuniform temperature distribution, both of which may create unfavorable operating conditions in the thermochemical conversion systems. On the other hand, higher bulk density may result in lower transportation and storage costs and lower emissions during combustion. A good quality pellet will have a density of 650kg per m<sup>3</sup>. The pulverization of cotton stalk can increase its density to 1080kg per m<sup>3</sup>.

Residues <sup>a</sup>	Moisture content (%)	Average particle size (mm)	Bulk density (kg m <sup>-3</sup> )	Porosity (%)
Wheat straw	7.79	0.42	160.75	51.25
Rice straw	6.58	0.40	166.29	83.20
Corn stalk	6.40	0.49	127.32	58.51
Soybean stalk	7.30	0.43	242.34	68.03
Sugarcane stalk	8.15	0.55	110.86	77.58
Coffee husk	7.86	0.67	349.06	64.85
Cotton stalk	7.45	0.38	230.55	74.55

## 2. Cotton Stalk Pellet Processing Technology

The usual pelletizing process includes: crushing, drying, pelletizing, cooling and packing. There are some differences in the cotton stalk pellet production line. Because of low moisture content of cotton stalk, the drying is unnecessary during the whole process, which bring a lot of convenience during production. On the other hand, the cotton plant is susceptible to many diseases, pests and weeds and requires large amounts of pesticides and herbicides throughout the growing season, many of the chemicals used are labeled as “Do not feed to livestock any crop material that has had this chemical applied” and it can also influence the combustion. So before pelletizing, the raw material should be cleaned by some way.

## 3. Our Cotton Stalk Pellet Machine

Cotton stalk pellet machine is developed according to the needs of the market, it is the equipment which takes corn straw, cotton straw, rice straw, sawdust, wood powder, sawdust, peanut shells, rice husk and other agricultural wastes as raw materials to make them into pellet fuel. The finished particles after molding can be used in the fireplace, boiler, gasification furnace and biomass power generation factory. It also can be applied to the low-temperature granulation of biological fertilizer, organic fertilizer, compound fertilizer and so on.



#### 4. Comparison between Cotton Stalks and Cotton Stalk Pellets

Material	Moisture Content	Ash Content	Average Density	Diameter	Calorific Value
Cotton Stalk	Under 20% Dry Base	6.68%	500kg/m <sup>3</sup>	50mm	3700Kcal /kg
Cotton Stalk Pellet	0.62%	2.02%	1120kg/m <sup>3</sup>	6mm	4231Kcal/kg