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Investigation & Survey of

Manufacturing Technology of Biomass Pellet Fuel

I. Introduction to Biomass Pellet Fuel

Energy is the foundation of our existence and development. The continuous consumption of non-renewable energy makes human beings turn to exploit and utilize renewable, environmental-friendly biomass energy, which takes biomass fuel as a representative. Biomass energy has become a strategic choice for the sustainable development of civil society and the development direction. It can not only supplement the shortage of the conventional energy sources, but also has great environmental benefits. Compared with other biomass energy techniques, biomass pellet fuel is easy to achieve mass production and use. It can rival gas and fuel oil in

convenience.

II. The Necessity of Developing Biomass Fuel

With the increasing consumption of traditional energy, new energy should be exploited because of serious shortage of resource. In China, we own rich pellet fuel resources. At present, the main resources can be exploited and used includes: crop straw, fuel wood, residues, waste wood in the municipal solid waste and something else. According to the theoretical calculation, our wood pellet fuel resources can be up to 5 billion tons. Biomass pellet fuel usually refers to solid fuel of cylinder shape which is less than 25mm in diameter. The density of pellet is increased before compression can be up to 1.2-1.4kg/m³. A 75% to 90% reduction in volume, so that it's easy to be stored and transported. The size is in uniformity with good fluidity, facilitating automated transmission and combustion. Pellet fuel is a kind of natural biomass fuel, during producing process, there is no need to add adhesive. Result of low moisture content, it's easy to adjust combustion air and the combustion efficiency is high. Average gas emission produced by combustion is 1.2g/h which is much lower than 7.5g/h stipulated by USEPA. Biomass pellet fuel in granular or block-shaped may greatly raised the combustion efficiency of materials. Thermal efficiency can increase by more than 80%. According to calculations, heat generated by 1.2 t wood pellet and 1t coal is equivalent. Biomass pellet fuel comes from biological waste without chemical substances, such as fissile and explosive chemicals. The poisoning, explosion, leakage accident will not happen during combustion.

III. The Development of Biomass Pellet Fuel at Home and Abroad.

3.1 The Usage and Manufacturing Technology Development of Biomass Pellet Fuel at Home and Abroad.

3.1.1 Development History

The usage of biomass pellet fuel burner started in 1970s, but until later 1980, many European countries(like Sweden，Finland，Belgium，France, Germany, Italy) began to attach importance to research and exploitation of biomass fuel technology result of world energy crisis and rising price of oil. Nowadays, it has formed the industrialized production with remarkable achievements. France starts to use straw pellets as the dairy cow feed. In recent years, they also research and produce block-shaped fuel. Converting forestry waste in briquettes with certain shape by mechanical pressing has reached the practical stage.

3.1.2 Pelletizing Technology

Drying: because of high moisture content in sawdust (usually 50%), it should be dried to the 9%-12% moisture content in the raw material to satisfied the need of forming. The dryer is equipped with direct heating rotary drum.

Powdering： After drying, raw material need to be powdered, hammer powder machine. The general size is 1mm.

Quenching and tempering treatment: it refers to soften wood fiber in raw material, replenishing and increasing high-temperature steam into raw material. More than half pellet fuel plant adopted this technique during production.

Pellet-forming: Most of the biomass pellet plants adopt the die roll extrusion molding principle，that means vertical ring die forming machine, and capacity is 2-4t/h. The major components have

long service life. Ring die is 2000-3000h and the compression roll is 1000-1500h.
Cooling: The temperature of pellets discharged from pellet mill is about 100 ℃, pellet in that condition is easy to be break and should not be stored and transported. Therefore, pellets need to be cooled down by cooler with counter flow cooling principle.

Picking and packing: After cooling, pellets are picked and packed according to consumers' different needs. Packing specification may be classified into small bag(16kg) and large bag(900kg) by different needs. For the large customer like thermal power plant can be transported by trunk or boat in bulk.

3.1.3 Analysis of the Using Condition

Taking America， Sweden and Austria for example, the application scale of biomass energy respectively account for 4%, 16% and 10% in their primary energy consumption. In America, the total installed capacity of biomass energy generation is more than 1MW, and the unit capacity is 10-25MW. The biomass pellet fuel burning equipment in Japan, America and some European countries have been industrialized in heating, drying and generating areas. The biomass pellet fuel and matching efficient clean combustion heating stove has been very popular, the heating efficiency ban achieve 80-95%.

3.2 Using Condition and Manufacturing Technology Development of Domestic Biomass Pellet Fuel

3.2.1 Development History

Relatively speaking, we started late of researching and producing in this area, but we pay much attention to it. From 1980, our government put research and application of biomass fuel application technology into the national key tackling item. Technology of biomass energy has got into a higher stage. The spiral pushing type straw forming machine introduced in 80s has formed a certain scale. But our research in mainly focus on large and medium-sized livestock and poultry biogas engineering technology, straw gasification and gas centralized supply and landfill power station. For manufacturing of biomass pellet fuel production and research on direct combustion, we have a long way to go. In some universities and scientific research institutions, certain achievement and production scale has been obtained in recent years.

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foreign burner technology and according to the specific situation of China, its burning chamber adopts the method of secondary air supply result to sufficient combustion and high thermal efficiency. Environmental protection and energy saving for the heater was developed on the base of importing advanced foreign fireplace and combined with our actual situation. By changing the size of machine, improving pellet feeding system and increasing the area of heat exchange tube, this kind of heater is suited to household use.

3.3 Development Trend and Advice

3.3.1 Government constantly improves the relevant policies of biomass pellet fuel production and utilization and establishes the fuel standard system.

Currently our country has made related laws and programs on biomass energy, also a number of pellet fuel industry systems were adopted and we had built biomass pellet fuel standard system. However, our pellet fuel industry was at an early stage of development and not completely accepted by the market.We need to make specific policies and measures to promote the exploitation and utilization in pellet fuel and guarantee the existing laws and policies can work effectively.We need to give great support especially in equipment manufacture and utilization of market exploration in pellet fuel: make perfect technical condition and standard on the aspects of biomass stoves,boilers and combustors.

3.3.2 Improve the quality assurance system and build national biomass fuel and combustion equipment certification testing center.

EU has mature and perfect quality guarantee system,before the pellet fuel and burning equipment entered the market they need to be tested through inspection department.Since the pellet fuel in china has just started, the guarantee system is imperfect, the pellet fuel and burning equipment enter the market without testing and certification which make the quality of pellet fuel and burning equipment vary greatly, this affect the progress of biomass solid pellet fuel industry, therefore based on the current scientific research institution,we need to build comprehensive research institutions in a collection of research,detection and market exploration trinity to promote the market exploration, master the latest market information, accelerate the transformation of scientific research into the market and make scientific research reflects its huge social and economic value： at the same time we should learn from the EU in testing experience of pellet fuel,set up national biomass solid pellet fuel and burning equipment testing center.

3.3.3 Enlarge the zone of typical demonstration promotion, realize large-scale production and Combine with a raw material source regularly

Our county’s pellet fuel is based on crop straw,considering the problems of transportation radius, cost and storage in straws , our pellet fuel enterprises should focus on medium-sized enterprises who has production of 10000~20000tons annually so that we can realize large-scale production,also in view of vast territory,big thermal difference and different characteristics of straws,Demonstration projects should be set up in different areas to advance the development of our biomass pellet fuel industry and make it completely commercialization and marketization.

3.3.4 Further studying of the forming mechanism in biomass, Improving the design of equipment and minimizing damageable parts and reducing the energy consumption of pellet

equipment

At present the formed production of biomass pellet equipment in market is mainly hot type, it has the problem of high energy consumption and molding parts (screw extractor , molding , ring die, press roll etc.} easy to wear. We should do research in molding mechanism of biomass material, change the molding way and as much as possible to reduce the friction between the material and molding so as to extend the service life of die and reduce the cost.Wood pellets of small package in US market is $170/t, large package is about $135/t; The delivery price in Sweden is $150/t. The FOB price of bulk wood pellets in Amsterdam is $80/t. If we import ETS technology to produce wood pellet, the production cost is much lower than abroad. By calculation, mass production cost is about 240RMB/t, retail price is 329RMB/t($39/t), it is no doubt that this price not only in international market but also in china can fight with coal price. So the improved technology is also one of the effective methods to improve the utilization rate.

IV. Research on Ring Die Pellet Technology

4.1 Ring Die Pellet Mill Structure and Working Principle

Ring die pellet mill consists of motor,speed reducer gear box, principal axis, drive shaft, ring die, press roller, forced feeding machine, knife component, body and gate.The motor drives the ring die and make it rotation “the entering material in the ring die drive the roller rotation,when the material is delivered into working area through forced feeding machine”with the rotation of ring die and press roll “the material before the press roll was crushed into compression area,the material was crushed in the area”the interstice in material rapidly shrank “the stress and density inside materials increased” the elastic deformation of material is turned to plastic deformation”when the material has reached its’ density,it will be forced through a die hole,and after a certain time pressure “the material in a certain density extruded the die hole” and became the biomass pellet fuel.

4.2 Research Status on Ring Die Pellet Technology

On the whole development of ring die pellet mill, the working principle is same, but the manufacturing level and technical performance improved a lot. Nowadays the widely used typical ring die pellet mill includes:the ring die pellet mill in CPM company adopted angular gear reduction gearbox drive construction, it can realize double speed exchange by manual shift mode. It is called motion model pellet mill which the fixed ring die rotate on the hollow shaft of big gear transmission, the press roll is fixed on the solid shaft with fixed device.The ring die uses three-part ring die clamps to fix, easy to install and equips with automatic circulating lubrication system device,safety in use. The ring die pellet mill in Azeus Machinery Co.ltd company uses double roll press, ring die, single motor V-belt transmission device structure. It has high production efficiency, low operating cost, simple structure and convenient operation.The system can work automatic lubrication and control. It uses a single motor drive, hollow shaft, ring die, spindle, roller and big belt drive assembly etc, the tension of belt drive are supported by the tail cantilever of spindle which is high load bearing and in the partial load condition.The design, calculation and coordinating is high requirements.The ring die pellet mill in Munch company include two mill: ring die and Tapered roller flat- die.The structural form of ring die pellet mill is same as UMT company’s single-stage synchronous cog belt transmission in UK.The ring die pellet mill adopted v-belt drive in Munch, the large pulley is wide, engine base is made in cast iron, the machine is

rather weighting but go slick, low noise, the instance of the large pulley is energy-efficient.The fixed structure of ring die should use CPM three-part ring die clamp, if we use bolt ,it will spend much time.The system can work automatic lubrication and control.Three-roller ring die pellet mill is the present of UK UMT company's typical ring die pellet mill. Lots of companies are making similar products at home and abroad,the drive way includes gear type and belt type. The crown three-roller ring die pellet mill are all using synchronous cog belt transmission ,among these 350B type is adopted double motor synchronous cog belt transmission,others are all using double motor v-belts and Synchronous cog belt secondary transmission.

V. Conclusion

Biomass pellet mill will have a bright future ,However, because of different types of resources the development experience in foreign countries is not suitable for our country.We should establish relevant policies to encourage and supervise effectively in biomass pellet fuel and the development standard of the related industries.The ring die pellet mill has a great potential,it will effectively improve the production rate of ring die pellet mill in choosing right delivery view and increasing material-leading refining roller etc.