MAIN FEATURES OF NEW PELLETING SYSTEM

FEATURE	EFFECT
No special civil works required	*Lower investment cost*
Low electrical consumption	*Low operation costs; Faster return of investment costs*
High production rate	*Connected to the above; Faster return of investment costs*
Fully automatic operation	*Low operation costs;*
Easy unclogging operation	*Low operation costs;*
Low operating temperature: Pellets production almost at ambient temperature	*No emissions; No need of cooling devices; Immediate bagging capability;*
Acceptability of biomass mixtures	*Lower investment and operation costs*
Acceptability of high humidity raw materials.	*Less need of drying sections; Lower investment and operation costs*

As a result of the innovative technical features described above, the new pelleting system has a very low level of energy consumption per kg of pellet produced. Electricity is required only for operating the machines. Typical levels of energy consumption are as follows:

RAW MATERIAL	MOISTURE	PRODUCTION (kg/h)	ENERGY (Wh_e/kg)
Sludge, pulps, fodders	*10-40%*	*1500-8000*	*35-50*
R.D.F., compost	*10-30%*	*1000-6000*	*30-50*
Wood chips, tree cuttings, sawdust	*10-30%*	*600-4000*	*40-60*
Plastic materials	*10-20%*	*800-5000*	*30-45*

THE TWO PROCESSES IN COMPARISON

Characteristics	"New "	"Conventional"
Humidity (%)	*8 to 10*	*8 to 10*
LHV (MJ/kg)	*16.76 to 18.47*	*15.92 to 17.50*
Ash Remainder (%)	*0.5*	*0.5 to 2*
Density (kg/cubic meter)	*700 to 750*	*600 to 620*
Energy use per kg of product (Wh)	*70 to 100*	*120 to 200 + drying*
Indicative Prod. Cost (EUR/ton)	*30 to 50 + Resource cost*	*60 to 90 + Resource cost*

Indicative investment costs:*
Innovative pelletisers:

1) 1 t/h	*380,000 EURO*
2) 4 t/h	*650,000 EURO*
3) 5 t/h	*830,000 EURO*

**These figures are roughly estimated since every pelleting system has to be tailored on the customer's needs. -minimum 10 years time life operation guaranteed*

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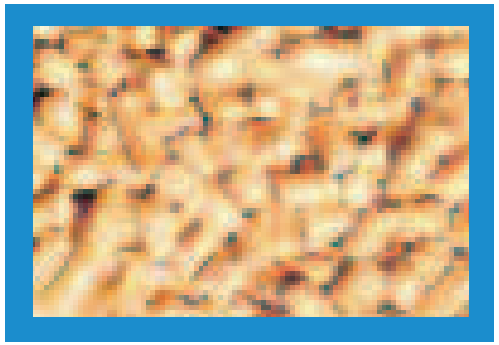
LATIN AMERICA THEMATIC NETWORK ON BIOENERGY

LAMNET

Refined Bio-Fuels Pellets and Briquettes

Characteristics, uses and recent innovative production technologies

G. Grassi



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THE IMPORTANCE OF COMPACTATION

for a wider biomass exploitation

All ligno-cellulosic materials such as timber, straw, paper and many vegetable fibres represent a valuable energy resource. The major problem for these materials is their large volume to weight ratio, making the handling, storage and transport not only difficult but expensive.

This problem can be overcome by refining this material by drying and then compressing it at very high pressure to produce fuel briquettes or pellets. These final products will thus have a higher density (more than double) and a high heating value.

In most developed countries the use of briquettes or pellets is mainly a matter of cost, of refueling service and of the will to mitigate the environmental pollution. In a country that has limited sources of oil, gas or coal but abundance of ligno-cellulosic resources, it would seem illogical not to utilise these valuable fuel products to reduce the import of conventional fuels.

This is especially valid for developing countries where the need for renewable fuels has reached a critical point.

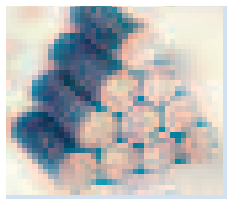
These countries have little or no money to purchase oil with limiting consequence for the growth of their economy and industries, however a large amount of electricity and heat is required for industrial processes.

Most of these countries have abundance of biomass raw material and waste such as coconut fibre, sugar cane, cotton plants, etc... but what is needed is a refining process to transform the wastes into a usable fuel. The briquetting and pelleting processes not only offer this opportunity but their technological level fits within these countries necessities.

Wood pellets are upgraded wood fuels which have been produced from sawdust, grinding dust, shavings, bark, etc. by drying and pressing the raw materials, which are leftovers after processing trees to timber and other wood products.

The main advantages of these processes are:
- *to increase the energetic value of residues for their immediate use or for further thermochemical conversion (combustion, gasification, pyrolisis, carbonisation)*
- *to lower the volume for storage*
- *to facilitate the handling, tranportation and to lower its costs*
- *to increase the energy density to volume ratio*
- *to eliminate the loss of material due to fermentation*

Fuel briquettes consist of peat, sawdust, chips and cutter dust. These substances are by-products from the sawmill industry and forestry practices. The material is pressed under high pressure in a briquette press.



THE PELLETS PRODUCTION

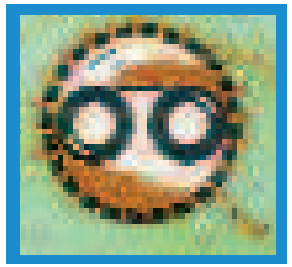
Generally, the production process of pellets has three basic stages:
1. *storing and pre-treatment of raw materials*
2. *drying the raw materials (at approximately 18-19% moisture content);*
3. *the pellet processing*

The production process follows these steps:
1. *Loose raw materials, after grinding to convenient size, are fed into pelleting cavity*
2. *Rotation of die and roller pressure forces materials through die, compressing them into pellets*
3. *Adjustable knives cut pellets to desired length*

With traditional pelleting systems, after one century of development and most widely used today, the raw materials are fed into the inside of the die and pellets are extruded to the exterior of the die, with the end product of pellets at an average temperature (effect of high pressure) between 100 and 120 °C. Another step of cooling the pellets has to be carried out before the pellets can be packaged.

Average production costs: 60 - 90 EURO/ton of pellets

THE TRADITIONAL TECHNOLOGY



Pellets extruded to the outside of the die

1- Storing and pre-treatment of the raw material.

↓

2- Drying the raw material

↓

3- Actual pellet production process

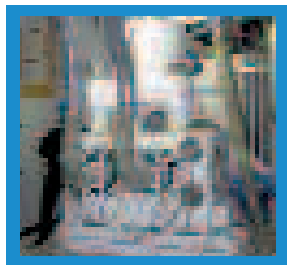
↓

4- Pellet cooling

↓

5- Pellet storing

THE INNOVATIVE TECHNOLOGY



Pellets extruded to the inside of the die

1- Storing and pre-treatment of the raw material.

↓

~~*2- Drying the raw material*~~

↓

3- Actual pellet production process

↓

~~*4- Pellet cooling*~~

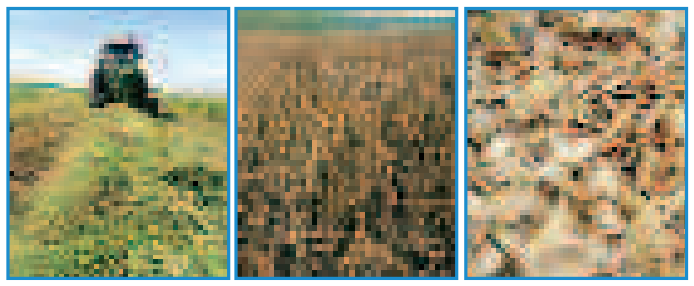
↓

5- Pellet storing

The new process is extremely versatile:
- *Only limited energy consumption is required, as no drying or cooling is necessary.*
- *The patented process permits high productivity and high pellet quality.*
- *The humidity content of biomass is 35% in general. Biomass with higher humidity content (50 - 60%) must be processed by two consecutive pelletisation steps.*
- *Mixtures of different biomasses can be pelletised without binding compounds.*
- *It can process material with variable size granules.*
- *Product stability, homogeneity and density are guaranteed.*

Only 50-100 Wh energy consumption is needed for processing one kg of material with a humidity range of 15 to 35 %.
This represents drastic production costs savings when compared to the conventional process.

Pellets Flowchart



LIGNO-CELLULOSIC MATERIAL

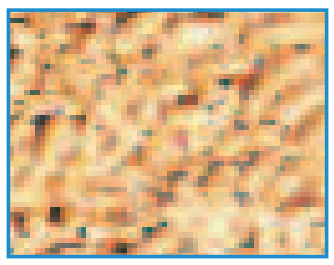
MECHANICAL PROCESSES

COMPACTATION

CARBONISATION

SYNGAS GENERATION

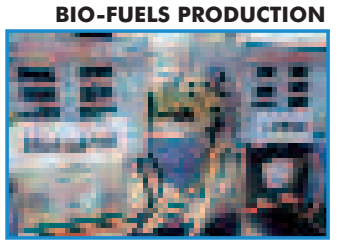
100% H_2 PRODUCTION



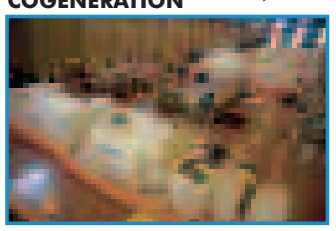
PELLETS

FLASH PYROLISIS

BIO-FUELS PRODUCTION



COGENERATION



GASIFICATION

The presented easy-to-operate pelleting system is innovative in the sense that moist raw materials (up to 35%) can be processed at low temperature (mechanically) carrying out simultaneous drying and compactation. Also the last step of cooling is unnecessary.

With this system, the raw materials enter from the outside of the die and pellets are produced inside. The temperature of pellets only increases to 10-15 °C and the maximum operating temperature of the dies is in the range of 55-60 °C. At such a relatively low operating temperature for the dies, there is no emission of smokes/fumes and/or vapours VOC and no cooling device is required.

Another advantage of this system is that it is able to pick up raw materials with a humidity of up to 35% without any furt special operation and hence the drying step can be avoided in most cases, with great operating costs and initial investment savings. For humidity content above 35% the biomass can be equally processed carrying out two complete operations.

The pellet mill is the core of the system. It is extremely versatile as it may process various types of loose materials, such as dehydrated biologic sludge by-product of water treatment plants, biologic or chemical fertilisers, pulps and slag from industrial processes, fodders, cereals, chaffs, husks, straw and stalk, growing waste, organic fraction of municipal or industrial solid waste, compost, paper and cardboard, fabric wastes, wood chips and sawdust, forestry residues, plastic materials, chemical products suitable for pelletization, etc.

The pelleting machine consists of one or two dies for producing pellets with diameters ranging from 6 to 16 mm and an external cylindrical shaped surface, with drawing ports placed in maximum pressure areas. The diameters and the quantity of the ports are function of the raw material and the desired size of the pellets. The operation of all possible configurations is totally automatic and is monitored by a microprocessor PLC-equipped switchboard. The microprocessor PLC can automatically adjust the system operating parameters to the characteristics of the raw material. Possible clogging can be easily removed by a simple reversed rotation of the dies, without any disassembling or other operations.

Average characteristics*

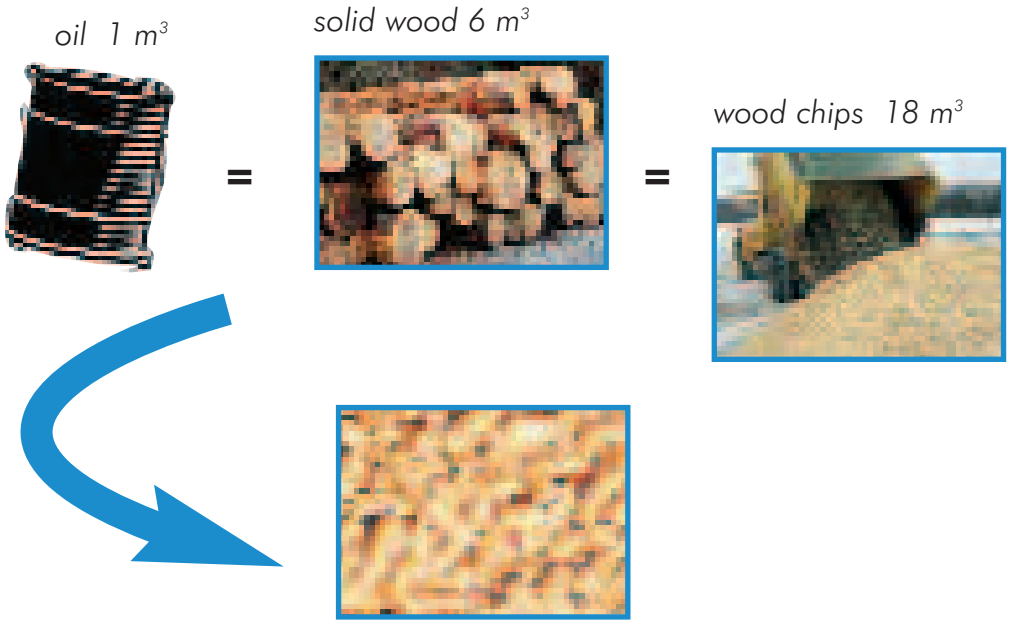
Specification	Pellets	Briquettes
Heat value	16.92 - 17.64 MJ/kg	16.92 - 17.64 MJ/kg
Density	650 - 700 kg/m^3	650 - 700 kg/m^3
Diameter	6 - 16 mm	~ 65 mm
Length	20 - 30 mm	25 - 200 mm
Ash contents	0.4 - 1.0 %	~ 0.5 %
Moisture	7 - 12 %	7 - 12 %

*Source: "Wood fuels basic information pack", Energidalen, Benet, et al., 2000

Utilisation*

- *Pellets are suitable for small burners (e.g. domestic stoves)*
- *It is possible to consider pellets similar to a liquid fuel in terms of alimentation of the burners (high automation is possible)*
- *Due to their bigger size and higher combustion temperatures, briquettes are not suitable to be used as a fuel in boilers smaller than 500 kW.*

Volumetric Energy Content



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The activities of LAMNET include the analysis of available bioenergy technologies and systems as well as the development and implementation of policy options for the promotion and deployment of bioenergy.

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