RICE STRAW POWER - NAWARO Project

Healthy Heating and Living Environment from Rice Straw
The eternally Renewable Resource

Concept Study
Leipzig, November 2014
Translation Mr. Bradley Schmidt, Adjunct Instructor at the University of Leipzig

Modified Loose and Solid Din-Plus Fuel
and Construction Material from Rice Fiber Pressed Plates






Analytical Report for the Fuel Rice Straw Pellets:

Parameter	Measurement result	Analysis Specification
High Caloric Value Hov (kJ/kg)	24566	Din 51900
High Caloric Value Hov (kWh/kg)	6.8	
Lower Caloric Value Hup (kJ/kg)	22606	Secondary fuels and
Lower Caloric Value Hup (kWh/kg)	6.3	Recycling Woodholz e.V.*
Moisture Content 1 v.A.I. (Ma%)	22,65	
Moisture Content 2 n.I. (Ma%)	6.6	DIN 38414
Ash Content (Ma.%)	6.35	DIN 51719

*Calculation of caloric content as per the Gütergemeinschaft Sekundärbrennstoffe und Recyclingholz e.V. (status 2003) [Community of Secondary Fuels and Recycling association]
1 Condition as received before processing or impregnation
2 Analysis of damp state after impregnation
The measurement values are based on the original substances we received after impregnation.
Fachhochschule Nordhausen / 99734 Nordhausen / Prof. Dr.-Ing. Schade-Dannewitz / schade@fh-nordhausen.de

This sustainably usable fuel leads to a condensed fuel with a clearly increased caloric value, for example, 4.9 kWh/kg to 6.5 kWh/kg. Additives and plant additives are utilized for the increase of caloric value. These products are biologically harmless and biodegradable. In conjunction with an oxidation promoting additive, the impregnation with natural plant oils achieved fuel optimization. Result = 29,000 t/a Rice straw + plant oil +++ technology = 35,000 t /6,3 kWh/kg of loose or solid fuel.

Development, production and sales of non-flammable product systems made of fibers from the renewable resource rice straw**.** With the world-wide reduction in and increased price of primary resources, renewable resources gain importance in the macro-economic circulation. Through intelligent innovation based on the renewable resources, efficient, economic, and profitable solutions can be realized with the development of new products.






Fire protection plates for the constructional building of houses / sawed and milled for the constructional interior fittings
Cable runs, carriers door and window elements / knows dyed with completely fine surface

System for the production of fuel pellets from rice straw

The necessary systems engineering is available and can be offered for various outputs. The know-how transfer as well as the use of license-based patent and property rights are part of the total delivery package.

The competition between wood pellets common today and new straw pellets.

Wood pellets are dependent on the exploitable wood supply, which is becoming increasingly rare and expensive, and depending on the tree type, trees need between several years and decades to be able to be harvested. In contrast, rice straw pellets can also rely on the annually available, inexpensive rice straw that grows world-wide. The necessary shredding step is simpler and less expensive with rice straw than with wood raw material.

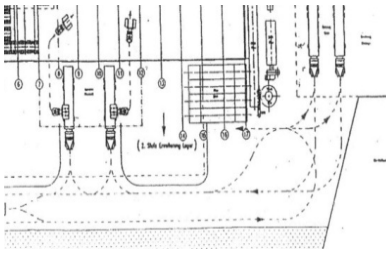
In addition, the damp wood materials have to be dried in a highly intensive process for preparation and utilization. This step is not necessary with rice straw. Due to its uniformly thin structure, the impregnation of rice straw is easier and more effective with the irregular wood particles. But it is necessary to retain the desired pellet characteristics. Today pellets are nearly exclusively produced from wood supplies. In order to protect wood resources, now a generation of solid herbaceous fuels was developed and the possible uses of herbaceous fuels were developed and the possible uses of grain straw have been proven.

In addition to the topic of “emission control,” the specific caloric value determines the usefulness of the fuel. Most organic raw materials or surplus raw materials have a limited caloric value, e.g. of 4.5-5 kWh/kg. Among other things, the caloric value is determined by the material’s density and humidity. Frequently the fuel has to be dried, which weakens the energy budget. The use of loose fuel is technically difficult and only sensible for large combustion plants. That is why transportable and storable condensed products were developed such as pellets and briquettes. These can also be used in small combustion plants. Among the raw materials available, wood, mostly in the form of organic residual material, e.g. sawdust, was able to assert itself. The demand for this heating material ultimately led to the scarcity of the raw material wood, and therefore a price increase for wood pellets, in 2006 up to EUR 280 per ton.

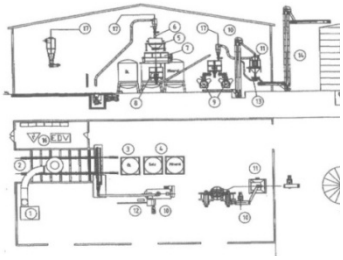
Wood is a raw material in demand for paper, wood material, furniture, construction elements, etc. For this reason, people have remained open to alternative materials available in a wide scope. Renewable resources and agricultural materials offer themselves for the task. Solid herbaceous fuels represent an alternative. This includes nearly all kinds of straw produced by grains, oil plant stems after harvesting oil, residues after oil pressing, residues such as rapeseed oil cake and comparable axillary products. Now we will focus on these resources with the question of refining possibilities and the qualification as a better fuel.

With straw, this development leads to an increase of the caloric value of 4.5 to ca. 6.5-6.8 kWh/kg. This fuel optimization is caused by impregnation with natural plant-based oils in conjunction with the oxidizing additives. The modified pellets or briquettes still remain less expensive than that of wood despite the increased caloric values.

Production and exterior, arrival and departures for truck

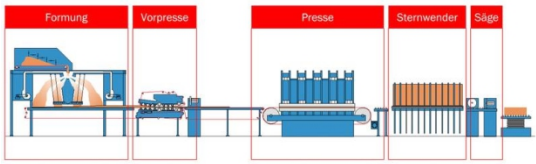


System diagram for pellet pressing



29,000 t/a rice straw + plant oil +++ technology = 35,000 t /6.3 kWh/kg solid fuel

Particle board production from rice straw



Example scheme – Particle board production with heated single-opening pressing system:

Purifier Crosslapper Opener Straw

Mixing **Vlies line** **Cutting** **Sanding**

With the world-wide reduction in and increased price of primary resources, renewable resources gain importance in the macro-economic circulation. Through intelligent innovation based on the renewable resources, efficient, economic, and profitable solutions can be realized with the development of new products.

Unique selling points and customer value of the developed products are in the foreground of the planted project.

Despite the increasing acceptance of products from renewable resources, in addition to the technical parameters, economic profits, efficiency and the relative advantage vis-à-vis the available products are the focus in a purchasing decision. These are the prerequisite for a sustainable success of the project in the area of renewable resources and in that way, form the most important foundations for an investment decision.

A consistent implementation of the innovation and developmental strategy in the area of fibers from renewable resources led to the development of non-flammable products made of fibers from renewable resources, among others, non-flammable pressed plates.
The non-flammability of the organic fibers is achieved through the impregnation with flame inhibitors with a patented vacuum impregnation process. The non-flammable products can be produced in an extrusion or pressing process with the fibers handled by fire protection technology.

Collection of raw materials from the field

Harvest in the field Unimog with cutting unit for production of 30m³ /1000 ft³

The disadvantages of traditional rice cultivation worldwide

Methane producing microorganisms in the dirt of the rice fields

“Flooded rice fields are a significant source of atmospheric methane.
Up to 15 percent of the emission of the greenhouse gas worldwide can be traced back to this habitat.

In this context, methane largely emerges as an end product of the energy metabolism of certain microorganisms, the methanogenic archaea. These organisms live in the root zone of the rice plant as well as in the surrounding rice field earth. There are various groups among the methanogenic organisms, though the groups named “Rice Cluster I” (RC-I) were recently identified as the main producer of methane from rice fields.
Because there were no pure cultures available for the RC-I to date, the competitive advantages of this organism were only recognized through the complete sequential analysis of the RC-I genome.”

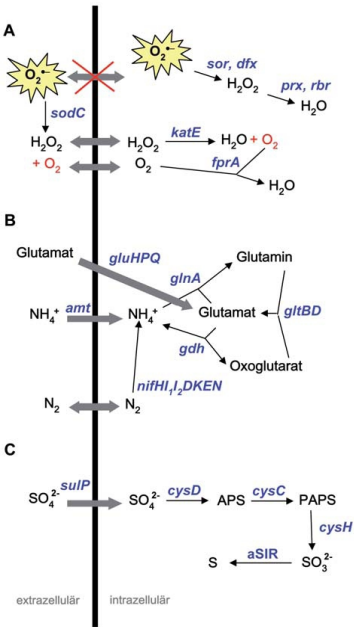


Diagram of the resulting enzymatic reactions to **A**, oxidative stress response,

B, Nitrogen assimilation and **C**, assimilating sulfate reduction in **RC-I** MRE50°

Max Planck Institute (MPI) for Terrestrial Microbiology in Marburg, Germany, author PD Dr. Werner Liesack in BIO*spektrum* : 618 Wissenschaft : 06.07 : year 13

Flooding the rice field

Burning the rice straw on the field









The Business Segments

and unique selling points for products made of rice straw:

1. Delivery of fuel from modified loose rice straw for combustion with
   10-15 % carbon dust in the biomass of heat and power station with cyclone flow burners.
   This flow-enable rice straw mix have the same advantages as in point 2.

2. Production of fuel pellets from rice straw
   this raw material leads to a condensable fuel with a clearly increased caloric value, for example
   of 4,9 kWh/kg to 6,5 kWh/kg. Goods for trucking bulk materials and bagged goods.
   the following advantages are achieved:
   1. Reduced transport volume through 30% more performance
   2. Annually accessible
   3. Binding of fine particles
   4. Integrated oxygen release
   5. Efficient burn ratio
   6. Reduction of polutant emissionens
   7. Reduction of ash content
   8. Increase of residual ash softening point, with residual ash usable as fertilizer

3. Production of rice straw fiber pressed plates

   in all fire protection classes for the production of furniture and prefabricated houses, diameter of up to 125 mm
   - Formaldehyde-free (“E 0”)
   - Emission-free
   - Ecologically harmless
   - Completely recyclable
   - Exceeds the requirements set by EN 312
   - Minimal sources in accordance with EN 317
   - Excellent screw resistence on surface and edges
   - Low weight
   - Available in diameters up to 125 mm
   - Very good noise and thermal insulation
   - Can be used as laminated, varnished, and as fittings

4. Pick-up Store for rice straw fiber pressed plates and rice straw fire protection pressed plates with up to 42 mm diameter

5. Prefabricated house of water-resistant rice straw pressed plates in all categories of fire resistance with diameters up to 125 mm

   the following advantages are achieved:

   We reduce the methane production when the straw no longer rots on the field
   Reduced transport volumes through 30% more performance
   With new plantings, the “Bayer Tabela Projekt” is applied, and only then can it be guaranteed that the methane emissions can be reduced.
   The food rice is a side product.

Project Development: Hans Lothar Köhl und Michael G. Polotzek
Branch Office Leipzig - Tel: +49-341-22302417 / Fax: +49-3212-1071001 / email: koehl.58@email.de

Fuel pellets from rice straw !