



www.PelHeat.com

The Beginners Guide To Pellet Production

This beginners guide has been produced to help provide an introduction in to the world of pellet production. The guide will discuss the benefits of pellets and how they are produced. It will also discuss the differences between pellet mills, and the skills required in quality pellet production.

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Thank You For Your Interest In Pellets!

First off I would like to thank you for your interest in pellets. Since 2006 we have been involved in the pellet market. We have researched and experimented with various equipment and materials. This guide has been developed through those experiences. Before we continue with the guide, you are probably wondering who PelHeat are, and what we do!

PelHeat is a father and son team based in the UK. We live on a small farm in the Staffordshire Moorlands in the heart of middle England. As you can see from the picture we live in a rather exposed location, and back in 2006 we were heating our home with an oil boiler. Due to the cost of heating oil, we began to look into alternatives. We looked at various heating solutions, however it soon became clear that wood pellets were the most practical solution to save on heating.

However we were also interested in what other biomass materials can be processed into pellets. Therefore we purchased and installed a pellet boiler that could burn a variety of biomass pellets.

To view a video of our biomass pellet boiler, please click the link below:

<http://www.youtube.com/user/PelHeat>

We then began our own project of developing a small-scale mobile pellet machine. This machine included a hammer mill for size reduction, cyclone separator and finally a pellet mill. The equipment was all mounted on a trailer and powered by a Perkins diesel engine. We even had the project featured in Farmers Weekly, which is the largest farming magazine in the UK.

We used the mobile pellet machine to perform tests and experiments. It also taught us how complicated pellet production is. Unfortunately the mobile pellet machine was not suitable for sale due to various limitations. However, it provided us with extensive experience in processing various biomass materials into pellets. Anyway, lets get on with the guide!



Machinery

Pelletiser makes straw into fuel

By David Cousins

A mobile pellet-making unit being developed by a Staffordshire company could finally make small-scale pellet production feasible for farmers. That means they could produce fuel for their own use from rape or cereal straw by burning it in a biomass boiler and also sell the pellets locally.

So far the unit is still in prototype form, but Christopher Scott from maker PelHeat says that the first production machines should be on sale before the end of the year.

Existing pelletisers tend to be large, static, semi-industrial units costing from £50,000 upwards, he says. The PelHeat version, on the other hand, is based on a small trailer and can be towed behind a car or pick up.

The process involved is fairly simple, too, with material passing through a hammer mill, then into a hopper from where it is augered into a pellet mill that makes either 6mm or 8mm diameter pellets. Water or oils can be added at this stage to make the pellets bind.

The smallest model will be powered by a 24hp Perkins engine and has a typical throughput of 200kg of pellets an hour. Cost is expected to be about £20,000. Larger units, involving a 50hp engine and 600kg/hour throughput, are also in the pipeline.

Getting the straw into the machine simply involves unrolling a round bale and feeding it in by hand, says Mr Scott. Almost anything with a moisture content below 15% can be pelletised, includ-

ing wheat and barley straw, oilseed rape, e-ake (what's left after the oil has been extracted), dry woodchips, sawdust, miscanthus, canary or switch grass.

There are a number of biomass boilers on the market that could burn the pellets, and the unit wouldn't take long to produce the 10t or so that would typically be needed to heat a farmhouse for six hours a day during four months of the year with a 50kW burner. But the real benefit will come from selling the fuel locally to other biomass boiler users.

More information on the machine is on www.pelheat.com.

PelHeat mobile pelletiser in prototype form. Inset: Pellets made from barley straw.

1 Introduction In To Wood Pellets And Biomass Pellets

Over the last decade there have been two major factors that have been driving the growth of the pellet fuel market. The first is the consistent rise in the cost of fossil fuels and price instability, and the second is the increased attention given to the effects of using fossil fuels such as oil and gas on the environment. Other factors that support the case for pellets is that they are a fuel that can be produced locally, from local wood and biomass materials. Local pellet production and distribution can produce an affordable fuel, while creating local jobs and keeping the carbon footprint to a minimum.

But Why Pellets Instead of Just Logs?

One question that many people ask is why have pellets instead of just burning logs? Well there are many reasons, but firstly logs only come from trees that in general grow very slowly. Pellets can be made from practically any biomass material including straws, grasses, energy crops etc. For example hemp is set to be a biomass fuel leader.



From seed to harvest only takes 3 months, and hemp pellets have very similar combustion results to most wood pellets. The other main reasons for pellets over logs are that pellets burn much more efficiently. This means pellets produce less ash, less smoke and more heat. Also pellets have a uniform size, shape, density and moisture content. These consistent qualities make it possible to design highly automated combustion systems such as modern wood pellet stoves and boilers.

But Aren't Pellets Much More Expensive Than Logs?

It's true on a per weight basis for example one ton of wood logs compared to one ton of wood pellets logs are cheaper. However, you have to look at the details to do an accurate cost comparison. For instance wood pellets always have moisture content below 10%, and in many cases it is lower than this at around the 5-8% mark. You can be confident of this fact as its impossible for a pellet to have a high density and smooth surface with higher moisture content. However, wood logs are often sold with practically no drying taking place. Please note a seasoned log takes about two years to dry and even then you are still looking at moisture content of minimum 25%. Properly seasoned logs are also more expensive. The logs that many consumers compare the price to pellets have moisture content of between 40-50%. So these cheap logs are almost half water, and as we all know water doesn't burn very well. Wet logs cause low combustion efficiency, low heat and increased smoke and ash. Therefore with wood pellets a ton of fuel pellets last much longer than a ton of wood. Therefore on a cost comparison basis you should compare by heat generated, not by weight. On a heat-generated basis the cost of wood pellets is very competitive to logs. This also does not factor into the advantages of been able to use pellets in highly automated wood pellet stoves and boilers.

2 The Pellet Making Process

Purchasing a pellet mill is actually a very small part of been able to produce wood or biomass pellets. In fact at PelHeat we have to help many consumers who have purchased pellet mills from resellers and retailers without any support of actually how to use the pellet mill. On the face of it making pellets in a pellet mill may seem very straight forward, you put wood or biomass into the pellet mill and pellets come out the other end. Well the reality is very different as quality wood and biomass pellet compression relies on a combination of principles. These include proper material preparation, proper pellet mill operation and maintenance. **However, it is still possible for even the average homeowner to own and operate a small pellet mill. As with every process, its just about knowing what you have to do and when.**

Changes in Raw Material Particle Size

Before pellet compression in the pellet mill can take place the wood, straw, grass or any other form of biomass must be reduced in size. One fact that is not widely stated however is one of the most important facts in pellet production, ***"Only a raw material of consistent quality can produce consistent quality pellets"***.

Part of this consistency is the size of raw material particles used in the pellet mill. Particles, which are too small or too large can severally affect pellet quality and increase energy consumption.



Changes in Raw Material Moisture Content, Pellet Quality and Production Rates

One of the reasons pellet fuel is so popular is pellets have moisture content below 10%. This enables the pellets to burn very efficiently and produce virtually no smoke during combustion. Pellet production is a high temperature process. The right moisture content will produce the best quality pellets, reduce energy consumption and reduce pellet mill downtime.

Changes in Raw Material Composition and The Inclusion of Binders and Lubricants

In pellet production every raw material behaves differently, and some materials produce better quality pellets than others. Depending on the equipment used the composition of the raw material may need to be changed to produce quality pellets at a reasonable productivity. Changing the composition can include adjusting particle size or moisture content. However, it may also include adding binders and lubricants to help produce higher quality fuel pellets.

Changes in Raw Material Pellet Mill Feed Rate

Another adjustment that is not well known to impact on pellet production is the rate of feed into the pellet mill. Adjustments on feed rate and maintaining a consistent feed rate can be the key difference to how well the pellet mill operates, even if the raw material is perfectly prepared.

Changes in Raw Material Conditioning and Steam

Conditioning is the pre-treatment of the raw material before it reaches the pellet mill. Conditioning can include specific mixing techniques and the introduction of additional water or steam. Steam can be used to pre-anneal the raw material and start the lignin melting process. Though conditioning can have several benefits in some cases the benefits are negligible and in other cases it is simply not practical to use conditioning. Generally for large-scale wood pellet production steam is used.

Changes in Pellet Mill Operating Temperatures

Temperature is a key requirement in pellet production. Unless a certain temperature is reached in the pellet mill natural lignin will not melt. It is not possible to produce some biomass pellets for example wood pellets without sufficient heat. However, if the temperature is too high this can damage the pellet mill and particular consumables such as the pellet mill die, rollers, bearings and seals.

Changes in Pellet Mill Roller and Die Clearance

Another adjustment that can impact heavily on how successfully the pellet mill operates is the distance between the roller and die template. The roller and die are wearing consumable parts, due to the abrasive nature and pressure of compression. The distance set between the roller and die can impact on how much energy the pellet mill uses, the quality of the pellet, pellet mill productivity and the amount of fines produced. Correctly setting up the die on a pellet mill will also increase the life of the roller and die and reduce the cost of changing these consumable parts.

Changes in Pellet Mill Die Template Rotation Speed

The speeds at which the roller and die turn affect the complex relationships during pellet compression. Some materials require a greater time under compression, and therefore require a slower rotation speed. Also, the speed and torque requirements of the pellet mill change.

Changes in Pellet Mill Die Design and Metal Used

Many different forms of metal alloy are used to produce pellet mill die templates. Different metal alloys have specific advantages and disadvantages. Using the correct alloy is critical to reduce wear and increase production. The type of metal used also affects the finish of the die holes.

The Full PelHeat Guide Covers The 10 Steps Of Pellet Production

As you can see from the above information, there is a lot more to making pellets than simply dropping material into a pellet mill. For this reason we produced the PelHeat Pellet Production Guide to help consumers learn the steps to produce quality pellets from a range of wood and biomass materials. The Guide is broken down into ten steps, as you can see below

1. **Size Reduction:** Chippers/Shredders, Hammer Mills
2. **Material Transportation:** Fans, Cyclone Separators and Screw Augers
3. **Drying Solutions:** Rotary/Drum Dryers, Pipe Dryers
4. **Mixing Solutions:** Batch Mixers
5. **Conditioning:** Water and Steam Addition, Binders
6. **Pellet Production:** Round and Flat Die Pellet Mills
7. **Sieving:** Removing Fines
8. **Cooling:** Counter Flow Coolers
9. **Pellet Transportation:** Bucket Elevators
10. **Bagging and Storage:** Bags, Sacks and Silos

Help Answering Your Specific Pellet Production Questions

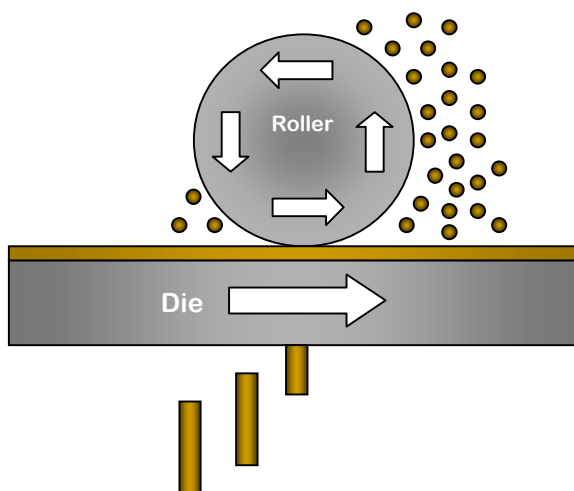
However, at PelHeat we also realise that no guide can possibly answer all the questions you may have on making pellets and the equipment used. For example you may have a unique set of objectives or limitations that you need help with. You may have already purchased a pellet mill and need help on how to use it properly. You may also require help purchasing pellet production equipment for your own use, a small business or even a large-scale project. If you become a customer of the full guide you will have exclusive access to be able to ask us your questions on making pellets and equipment. Please click the link below to purchase the full guide download.

3 The Different Types Of Pellet Mill

As you would expect there are various different types and designs of pellet mill. Each design has its own advantages and disadvantages that are discussed in the full PelHeat guide. The two main types of pellet mill are the flat die pellet mill and the ring die pellet mill. The flat die pellet mill was designed around the turn of the 20th century to produce animal feed. The ring die pellet mill design was not really developed until the 1950's. The original purpose for all pellet mills was to compress animal feed into pellet form. There were several advantages of processing animal feed into pellets. Firstly a specific blend of feed, minerals and vitamins could be produced for each animal. Also, in pellet form it is much easier to ration out each day the correct amount of feed for the animals without wastage or over feeding. Finally due to the compressed form of the pellet feed and increased density, transportation costs of delivering the feed to the farm were dramatically reduced. It was not until the 1970's when some animal feed producers started to experiment with producing wood pellets for fuel.

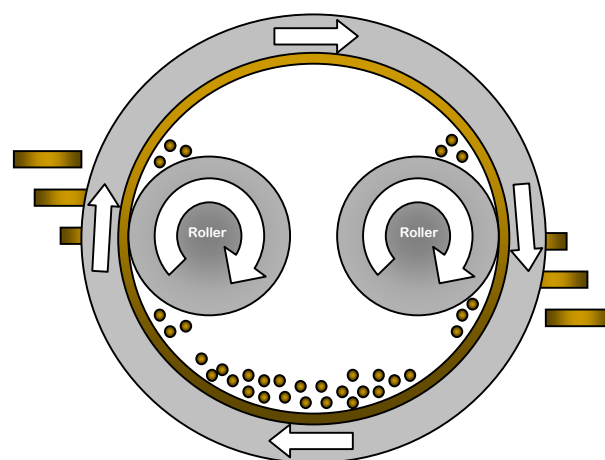
The Flat Die Pellet Mill

The image to the right depicts the basic design and process of the flat die pellet mill. A solid metal plate sits below a series of compression rollers. Material enters from above and falls between the rollers, which is then compressed through the die. The finished pellets then emerge from the base of the die and leave the pellet mill. This design of pellet mill is predominantly used for the small-scale production of animal feed, mostly in China. These same pellet mills are often promoted as wood pellet mills by many online re-sellers.



The Ring Die Pellet Mill

The image to the right depicts the basic design and operation of the ring die pellet mill. Unlike the flat die pellet mill design the ring die is positioned vertically instead of horizontally. The raw material enters the centre of the die and is compressed through the die with a series of compression rollers. Most ring die pellet mills have two compression rollers, however some ring die pellet mills have three maybe four compression rollers. The most common design of ring die pellet mill is where the die is powered and rotating, and the rollers move due to the friction and movement of the die.



For more information on the specific positives and negatives of pellet mill designs please review the full PelHeat guide. After you have read the guide we look forward to your questions.

4 Pellet Mills Sold On The Internet Through Re-sellers and Retailers

There are a large number of online retailers now offering pellet mills for consumers to produce their own pellets. There are hundreds of retailers based around the global who are now re-selling pellet mills to homeowners and business owners to produce pellets from a range of materials.

The PK/KL Pellet Mill Series

Before you visited the PelHeat website you may have visited some other websites selling pellet mills very similar to the images to the right. These pellet mills maybe offered with an electric motor or a single cylinder diesel engine. These units are produced in China. They are then purchased by retailers and re-sold through their own websites and shops.



The PK/KL series flat die pellet mill, the mill is produced in China for animal feed.

The Problems With Most Pellet Mill Re-sellers

There are several issues with most of the online retailers who are now distributing the PK/KL pellet mills:

The Pellet Mills are Miss-Sold With Inaccurate Descriptions

The PK/KL series was developed in China to produce an affordable pellet mill for Chinese farmers to produce animal feed pellets on the farm. Animal feed is made mainly from grass, which is a low-density material. The PK/KL series has been designed to cope with only low-density materials, hence it has not been designed to be able to deal with processing wood pellets. However re-sellers are advertising these pellet mills as been able to produce wood pellets for fuel.

No Pellet Mill Support Provided

As many of the re-sellers have no experience in using the pellet mills or making pellets in general they cannot provide any support to their customers on how to use the pellet mill correctly.



Small Flat Die Pellet Mill Powered By A Diesel Engine

The Pellet Mills are Re-Sold At Huge Mark-ups

Despite the fact that the retailers provide no improvements to the pellet mills and no support they have no problem in re-pricing the pellet mills with huge margins. We have owned a PK/KL series pellet mill purchased directly from the manufacturer. The usual mark up for a re-seller is 30% over the purchase price. We have found re-sellers charging between 100% and 200% mark up on the purchase price of the equipment from the manufacturers, which doesn't even include delivery.

5 The Problems With The Most Common Small Pellet Mills On Sale Today

As discussed in the previous section the most common pellet mills on sale today are the PK/KL series flat die pellet mills. As stated the PK/KL series was specifically designed to process low-density material such as grass for animal feed. The problem is most consumers are looking to purchase a small pellet mill to produce wood pellets.

Why Is Making Wood Pellets So Different?

Wood is a high-density material and performs very differently in the pellet mill compared to processing low-density materials like grass. Many people try and produce wood pellets with the PK/KL pellet mill. However trying to produce wood pellets with the PK/KL pellet mill does cause a high risk of damage to the pellet mill. The reason for this is wood pellet compression puts much more pressure on the pellet mill components.



The Die and Roller of the PK/KL Pellet Mill

Issues With Using The PK/KL Series Pellet Mill For Wood Pellets

Trying to make wood pellets has led to many reports of the PK/KL series developing cracked castings, broken shafts and broken roller assemblies. This has led to some claiming that the problem is purely down to poor Chinese build quality. However, this is an unfair assessment. The PK/KL range was designed to be affordable for Chinese farmers. It was not designed to be able to take the strain generated from processing wood and other biomass materials into fuel pellets.

Many consumers complain about the fact the pellet mills do not have sufficient power to process wood pellets, resulting in the motor stalling. This is very true, as the pellet mill is given a power rating to process low-density materials only. This is also due to a gearing issue, this is one of the main differences between the animal feed pellet mills and wood pellet mills.

I Want To Make Wood Pellets, What Type Of Pellet Mill Do I Need?

When looking for a pellet mill to produce wood pellets and other biomass pellets you need to look for products that are specifically designed for that purpose. The issue is that many pellet mill retailers will mislead you on the capabilities of their products. If you are looking to purchase a pellet mill of any size please use the information contained within this guide and the full PelHeat guide to quiz the retailer on their products. If they cannot accurately explain the features of the pellet mill for wood pellets this is a good sign that they have no experience of making wood pellets. The problem is green technology is a rapidly growing industry. Some people are just out to make quick and easy money without investing their time to actually learn how to make pellets and support their customers.

6 What Makes A Pellet Mill Fit For Purpose?

So what are the differences between say the PK/KL range and other pellet mills specifically designed to produce fuel pellets. As stated PK/KL range was designed to be a cheap pellet mill for low-density materials only. This is shown in the components used to produce the pellet mill.

The castings on the pellet mill are made as thin as possible to reduce cost. Also the quality of steel used is not up to western standards. Other features such as low quality bearings that are not designed to take the pressure of wood pellet production are an issue.

The Gearbox In Small Flat Die Chinese Pellet Mills

The gearbox within the PK/KL range is from a car differential. This part is used on most of the cars sold in China. This is a very cheap component. Placing heavy load on the gearbox has been proven to cause issues. Therefore when the pellet mills are used for wood pellet production the gearbox can fail. High quality gears are required.



Do These Issues Also Apply To Large Scale Pellet Production Equipment?

When you are purchasing pellet production equipment, cost is obviously a key point. However cost should not be the main factor when deciding which equipment is best for your needs. The issue is that many Chinese manufacturers place cost above all other factors. Many of the products they produce are much cheaper than the products produced by established equipment manufacturers. In attempting to produce the cheapest equipment they have also have to sacrifice the quality of the equipment. Also, while China may have decades of experience in the animal feed industry they lack the experience of producing quality pellet mills to produce wood pellets. Again, much of the large-scale equipment that comes out of China are actually animal feed pellet mills. These pellet mills maybe able to produce wood pellets for a short period of time, however the intense demands of wood pellet production will show eventually. Several customers of our guide have had to replace the original equipment they purchased from China within only a few months of use. Therefore choosing cheap equipment is really a false economy, there is a reason quality equipment designed for fuel pellets costs more.



Examples of Chinese ring die pellet mills

7 The Importance Of Knowing Exactly How To Make Quality Pellets

As stated in previous sections of this guide just purchasing a pellet mill, even the right pellet mill for your needs is simply not enough. At PelHeat we compare making pellets to cooking and so do many of our industry colleagues. As making pellets is more of an art than an exact science.

The Pellet Making Process Compared To Baking A Cake

So with cooking the first things you need are your ingredients to make the cake. With making pellets your ingredients are your raw material or perhaps a mixture of materials. Once your ingredients are ready you then have to prepare them. With making pellets there are several ways you have to prepare your raw material. Initially you will have to go through some form of size reduction, which in most cases will require a hammer mill.

The hammer mill will reduce the particle size of the raw material, the size of particle is dictated by the size of screen used. The size of particle produced has a huge impact on the quality of pellet produced and the productivity of the pellet mill. The second step of raw material preparation is to monitor and adjust the percentage of water the raw material contains.

Moisture control is one of the most crucial steps of pellet production, it will also dictate pellet quality and pellet mill productivity. Studies have also shown a raw material with moisture content 1% away from the ideal can force the pellet mill to use up to 20% more power per ton during production. Hence accurate moisture control is also crucial to keep energy costs to a minimum. To help the material make a quality pellet you may also need to add binders at specific percentages and lubricants to reduce the load on the pellet mill motor. Stalling the motor is very possible without good awareness.

When making a cake once the mixture has been prepared it is then ready for the oven. A pellet mill is simply the oven and press for the raw material mixture. Therefore just like when making a cake if the mixture is not correct the oven doesn't effect how good the cake is. Even with a raw material mixed and prepared correctly the pellet mill still needs to be set-up and prepared correctly or quality pellets cannot be produced. Just some of the aspects of setting up a pellet mill correctly are the roller and die rotation speed, the distance between the die and roller and proper conditioning of the die template to enable good product flow with good compression at the same time.

Too many people get influenced by the slick sales talk of pellet mill retailers into thinking making quality pellets is a basic process. Pellet production is a skill, but like all skills with the right education you can master making quality wood and biomass fuel pellets.

Thank you for your attention

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