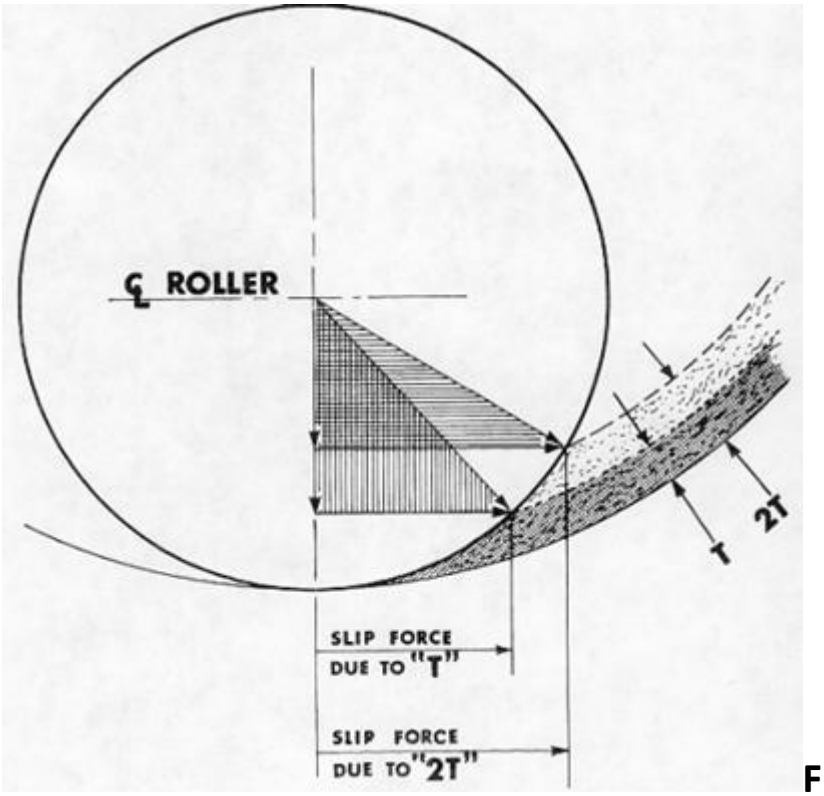
STUDY ON DIES FOR WOOD PELLET MACHINES

Definition of pellet dies

Pellet die can be simply defined as a metal part with holes, either flat or ring-shaped, in which the roller forces raw material under intense pressure to produce pellets. Theoretically, the pellet die driven by the main motor of a pellet mill is a driven component. The holes and thickness of pellet die determine the pellet size and features.



Function of pellet die

Theoretically, during pelletizing, the pellet die and the roller work together to produce the pellets. Roll force acts on the feed stocks relative to the contact with the die to compress and extruded the pellets. On the other hand, the radial force from pellet die resists feed stock flowing through the die holes. With the interaction of the two forces, the feed stock are formed into pellets with strength.

In the pelletizing chamber, the feed stocks are distributed evenly across the face of pellet die where the cross force of pellet die and rollers press the feed stocks trough the die holes to mold pellets which are cut off when extruded out of pellet die.

Types of pellet dies

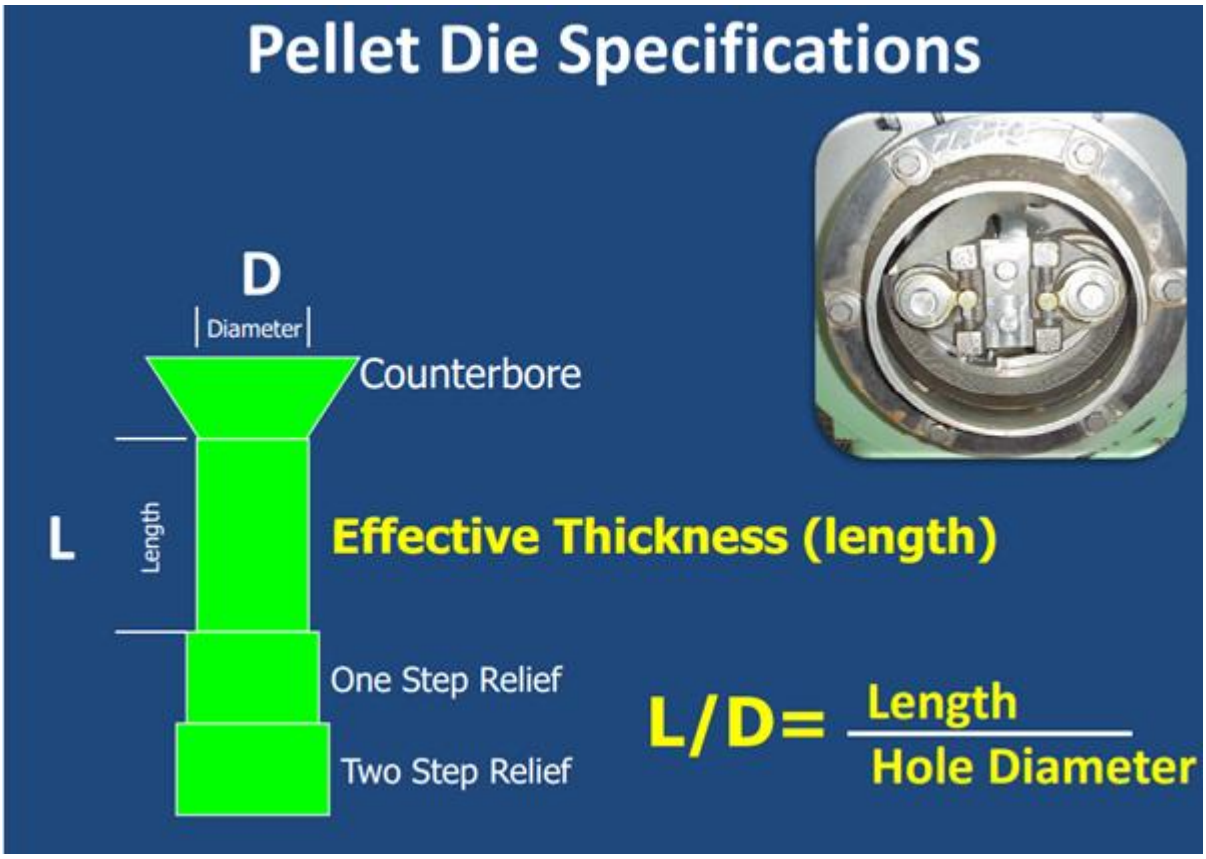
Flat die and ring die, for General, are the two dominated die designs used in wood pellet machine at present market. Flat die is featured as small in size and light in weight, easy to maintain and clean, most importantly, much cheaper than ring die. Ring dies are featured as expensive, large in size and heavy in weight, high capacity, less wear and durable, and low energy consumption.

Roughly speaking, the flat die is usually adopted by small wood pellet machine or homemade pellet machines for the low production cost and low purchase price while the ring dies are generally installed in the larger scale pellet machines for the high productivity.

No matter what the die shape is, the die determines the performance of the pellet production line. That's to say, the pellet die is the most important component of a wood pellet machine.

Pellet die design

The design of pellet die is very important because the pellet die directly determines pellet quality and production capacities of pellet mill, operation performance, and working die life, etc.



Generally, the following factors determine the pellet die design:

1. Metals

Pellet dies are made of metals, which determines the features and working life of pellet dies. Generally, pellet dies are usually made of the following metals, such as alloy, stainless steel, and "Chrome-Plus"stainless steel, etc.

- Alloy pellet die is satisfactory for pelletizing common feed stocks. However when the corrosive materials, the stainless steel pellet die may perform better.
- Stainless steel contented chromium can provide better resistance to corrosion, pitting and scoring and die hole enlargement.
- Pellet die made of " Chrome-Plus" stainless steel is usually a choice for pelletizing ingredients with strong abrasive or corrosive characters.

2. Inlet diameter and inlet angle

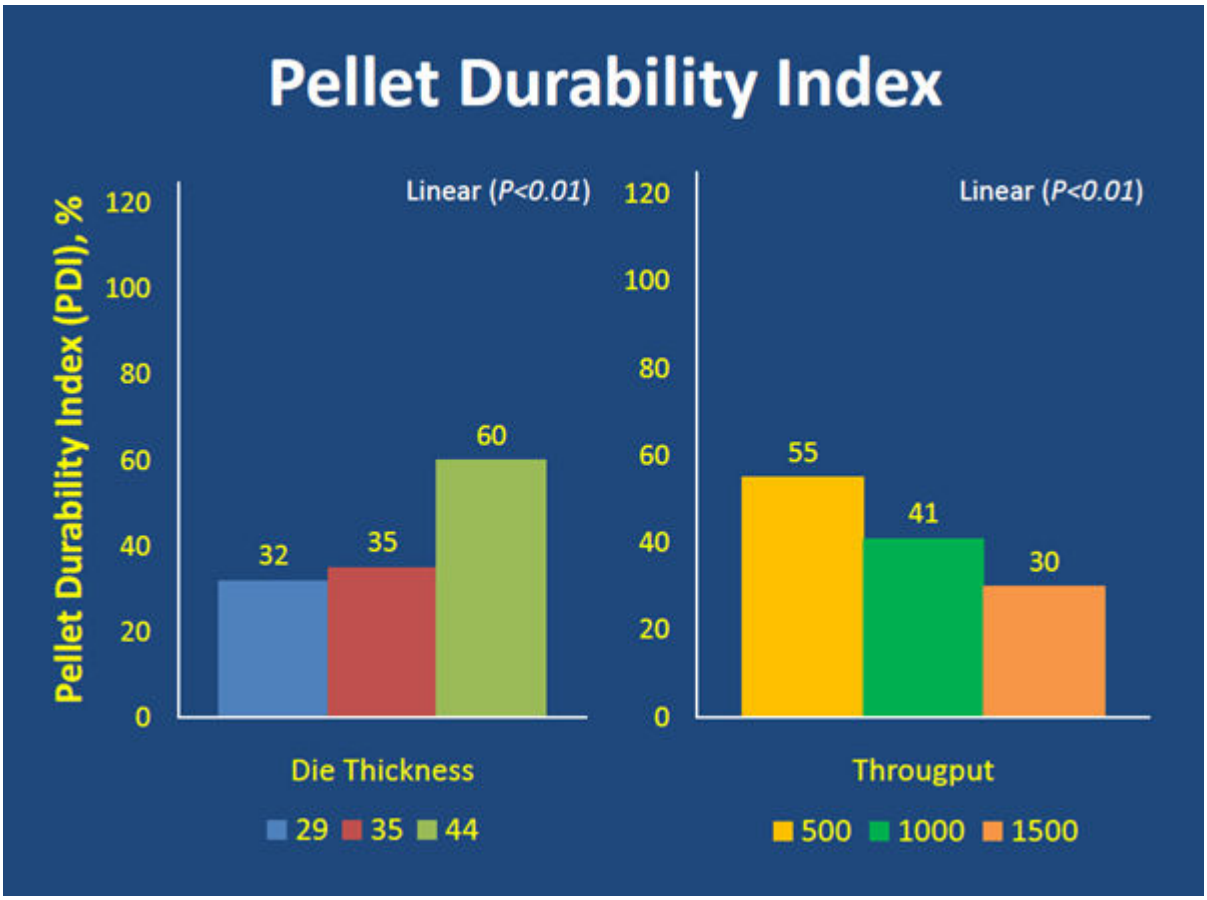
The inlet of die holes is countersunk into taper shape to let feed stock flow into die holes. The inlet angle is usually around 30o to 40o on small hole dies.

3. Thickness

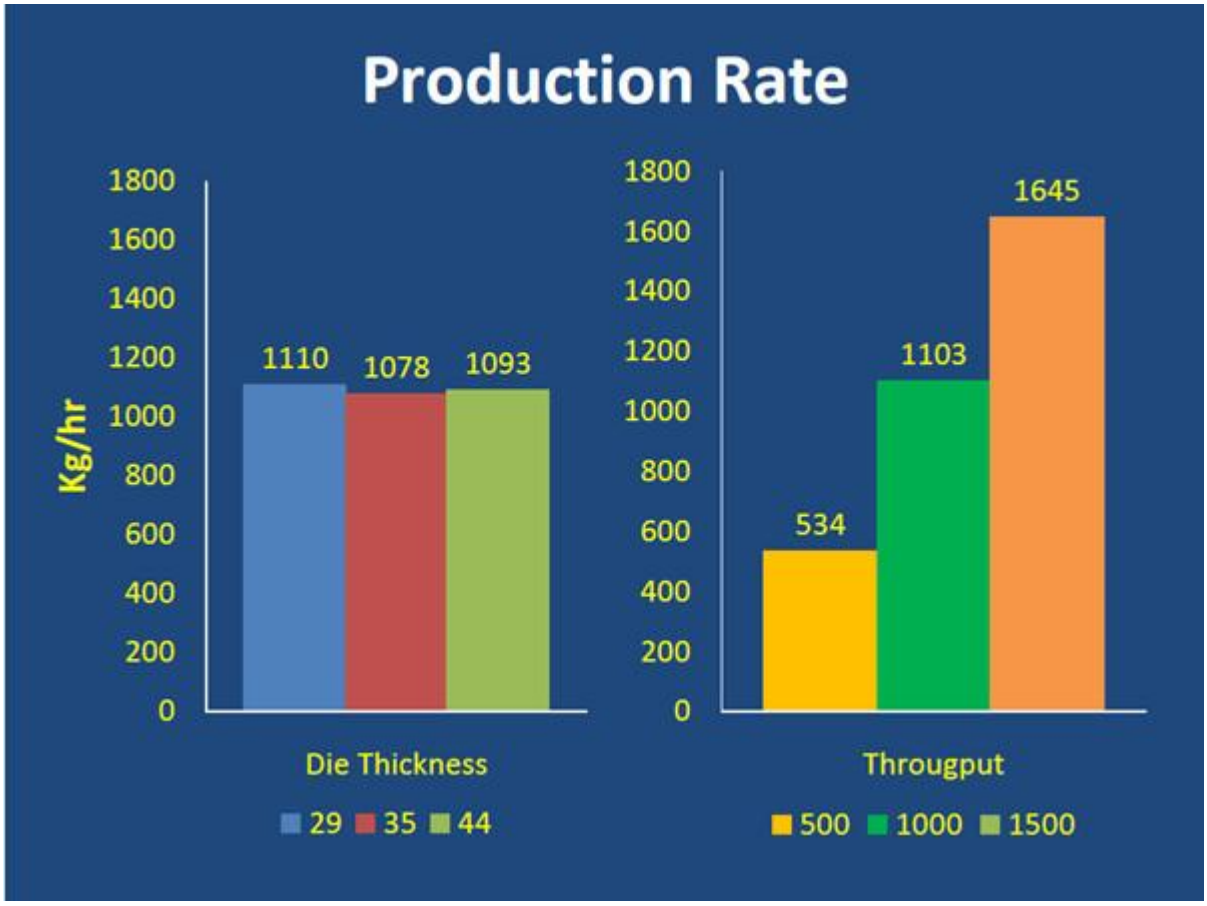
Thickness wood pellet machine die is another factor needs to be considerate. The thickness of the die can be divided into total thickness and effective thickness. The total thickness of the die refers to the overall thickness of the die which is larger than the effective thickness which refers to the working thickness of the pellet die, which the pellets are molded. The die is stronger when the die is thicker. Commonly, pellet die thickness increments vary by 1/4" between 11/4" and 5" thick.

The thickness has a decisive influence on how the material flows through the die. If it is too deep, the biomass materials cannot get sufficient compression to form pellet. And on the contrary, if it is too shallow, the biomass materials will get the pellet machine die blocked easily and shorten the service life of wood pellet machines.

In the study of C.R. Stark on influence of die thickness to feed pellet quality and production rate, he pointed out that thickness of pellet dies has a positive effect on pellet quality and negative effect on the production rate.



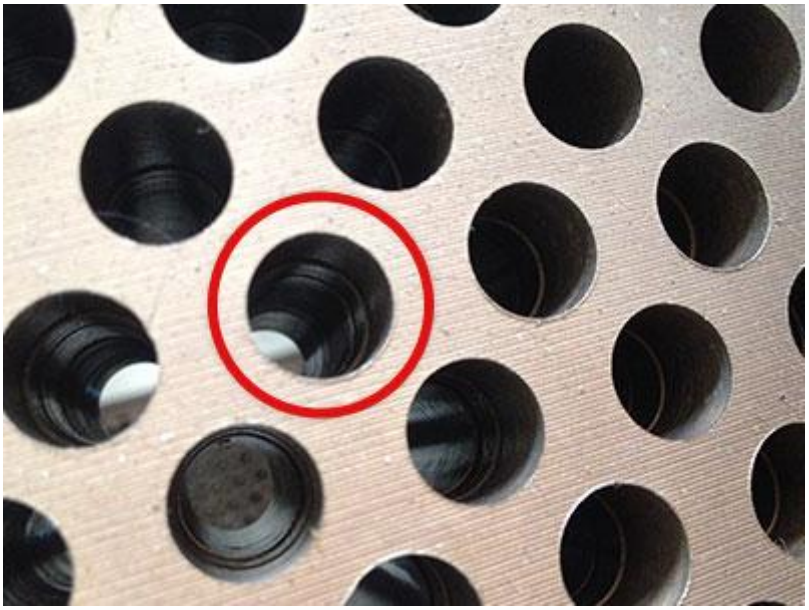
Positive effect of pellet die thickness to the pellet quality.



Negative effect of pellet die thickness to the pellet production rate.

4. Drill pattern

The die hole type is another important issue. At present, the state-of-the-art step-shaped die hole has been practically proved to the most successful and mature design for pellets production and, in particular, for wood pellet production. This picture below shows what a step-shaped ring die hole looks like:



Step-shaped die hole

This design mainly benefits in greatly extending the service lifespan for a ring die, which is known to be the most worn part in pellet making equipments.

5.Relief depth

The relief depth refers to depth difference between pellet die total thickness and effective thickness. The design of the relief depth is meant to promote strength of pellet die by adopting thicker die while at the same time do not harm the flowing rate of feed stock.

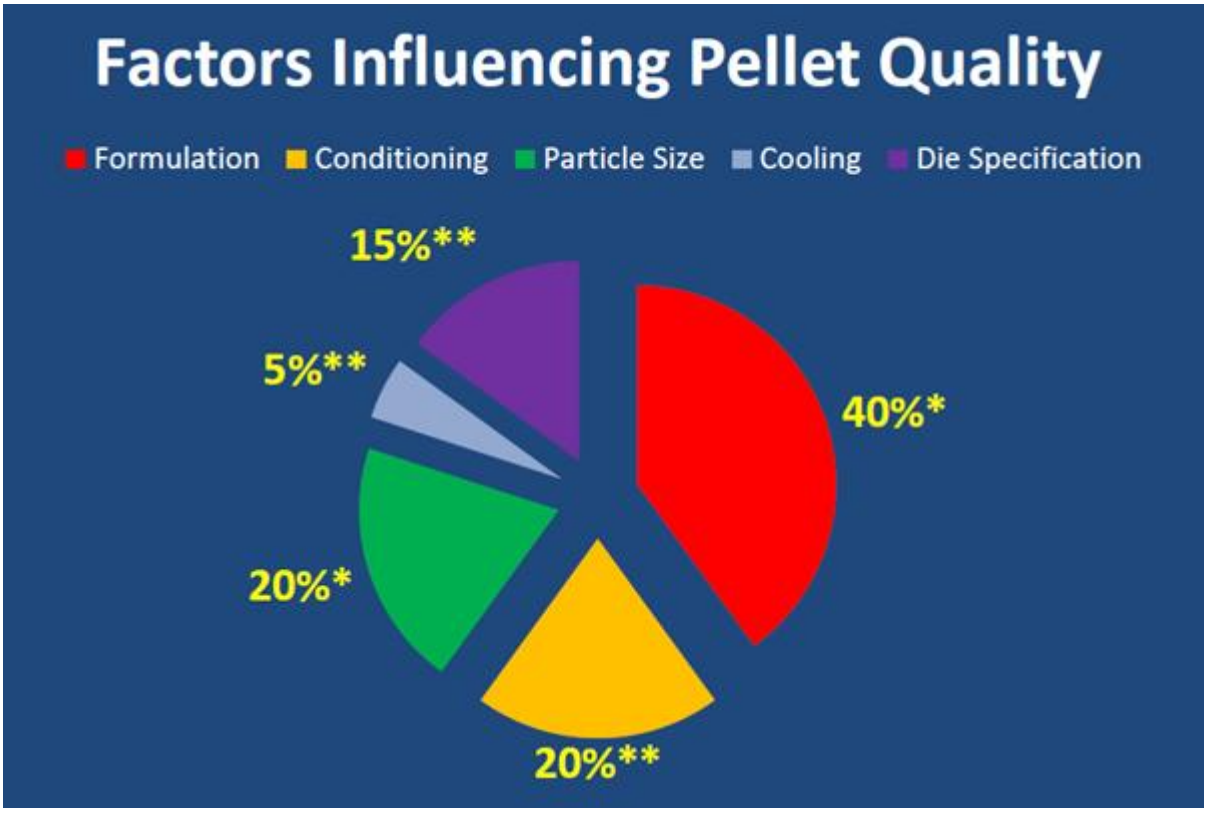
6.Hole count

Hole count refers to the numbers of die holes in a die. The more die holes, the higher of the production capacity and the lower of pellet die strength. That's to say, the hole count influence the pellet production capacity and pellet die working life.

Ring die with different die hole counts

Conclusion

Pellet die specifications include inlet diameter, inlet angle, total thickness and effective thickness, trill pattern, hole count and relief depth, etc. According to C.R. Stark's study, die specifications consisted of the mentioned factors influence pellet quality largely, shown in the following diagram.



Pellet die selection

When purchase a pellet die, the following characteristics of pellet dies should be considered:

- Raw materials of the pellet dies, that's, the metals;
- Die compression, i.e., thickness of the die divided by the hole diameter;
- Hole characteristic, such as, the counterbores and reliefs depth;
- Layout of the die holes , that is, numbers of holes in a die, and number of rows of holes.

Pellet die trouble shooting

1. For a new pellet mill or new pellet die, it is not easy to form pellet. Then flushing of the new pellet die is needed to help the pellet mill to form pellets effectively.

To flush the die, mix fine sand in with the raw material along with a generous amount of oil. Recycle this mixture through the machine after it is discharged. Continue doing this for about ten minutes. To flush the die, mix fine sand in with the raw material along with a generous amount of oil. Recycle this mixture through the machine after it is discharged.

Continue doing this for about ten minutes. And then the pellet mill can produce pellet normally.

2. When finishing production or turning off the pellet mills, pellet mill should be fed with oily materials to fill the die holes to prevent rusting and die hole blocking.

3. When the die holes are blocked, flushing the die helps mitigate one of the most common problems: excessive blockage. This process essentially smoothes the bored interior of the die's holes in which burrs may remain from the manufacturing process. After flushing pellet die for about ten minutes, you will notice that blockage occurs far less frequently.

Well, there are a lot of things can be talked about pellet die and machines. Feel free to contact us if you have any problem about the pellet dies or about the wood pellet machines.