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Factors Affecting Quality of Pellet and Feed Mill Efficiency

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Introduction:

Dairy farming practices are changing rapidly. The most significant change has been in the area of feed requirements for optimum productive and reproductive performance of dairy animals. Genetic upgradations of dairy animals are constantly pushing feed manufacturers to produce quality feeds that can fulfill the increased requirements of such improved breeds without creating additional physiological or health related issues. Manufacturing feed in pellet forms has been one of the advancements in feed production as pellets have their own advantage over mash feed. By feeding a pelleted feed, the animal is more apt to receive a totally mixed ration than one that has separated through these processes. It also prevents wastage, destruction of pathogens, less time and energy expended for prehension and improved palatability. Bulk density is increased, which enhances storage capabilities of most bulk facilities. Shipping facilities are also increased, thereby reducing transportation costs. Almost all farmers accept that animals make better gains on pelleted feed than a meal ration.

Advantage Of Pellet Making

- The heat generated in conditioning and pelleting make the feedstuffs more digestible by breaking down the starches
- When pelleted feed is fed, each animal receives a well-balanced diet by preventing the animal from picking and choosing between ingredients
- The pellet simply makes the feed in a concentrated form
- Pelleting minimizes waste during the eating process

Pellet Feed

Pelleted feed can be defined as "agglomerated feeds formed by extruding individual ingredients or mixtures by compacting and forcing through die openings by any mechanical process". Basically, the purpose of pelleting is to take a finely divided, sometimes dusty, unpalatable and difficult-to-handle feed material and by using heat, moisture and pressure, form it into larger particles. These larger particles are easier to handle, more palatable and usually result in improved feeding results when compared to the unpelleted feed. Pellets are generally formed with diameters from 10/64" to 48/64" with somewhat longer than the diameter. By combining moisture, heat and pressure on feed ingredients, a degree of starch gelatinization is produced which allows animals and poultry to better utilize the nutrients in these ingredients.

Friction, fines and shrinkage are some of the terms frequently used in feed milling operations.

Friction

Friction is the difference in temperature of the feed entering the pellet mill die and the pellet being discharged from the die. The difference reflects the mechanical energy required to produce a pellet. There are several inherent factors that can affect friction:

- Moisture addition to the feed ingredients
- Steam temperature and pressure Conditioning
- Ground particle size of feed ingredients
- Physical properties of the feed ingredients

Other factors relating to friction are die size in terms of hole diameter and thickness. High friction (over 30°F) results in reduced die and roller life, as well as increased bearing and gear maintenance.

Fines

Fines are the materials that result from pellets disintegrating due to poor quality or mechanical attrition. Fines are a function of moisture and high friction or oversized feed ingredient particles or poor conditioning.

Shrinkage

Shrinkage is the loss of weight of the original feed ingredient after pelleting. This loss is basically due to lack of moisture addition and high friction.

A high level of friction due to lack of moisture addition results in higher pellet temperature entering the cooler; and thus, more moisture is flushed off. Cooler removes moisture from hot pellet and it will not depend on the cooler inlet feed temperature.

Conditioning Process

After proper grinding and mixing the mix is forwarded for conditioning process. Conditioning is the most important element in achieving high quality pellets at high production rates

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at a low cost (in terms of animal performance).

Four basic reasons for conditioning process are:

- To lubricate for faster production rate
- For extending die life
- To reduce energy costs
- To gelatinize starch for nutritional value

Conditioning is almost universally accomplished by the addition of controlled amounts of steam. Uniform conditions at this point are extremely important for optimum results.

Pelleting:

The conditioned mash then flows by gravity into the pellet mill die chamber where rollers press the softened mash through the holes in a circular die. Stationary knives are located outside the circular rotating die that cut off the shaped, dense pellet at the proper length.

Pellet quality:

Pellets should have a desired degree of hardness, and should also show high resistance to abrasion during handling and transport. Pellet quality depends largely on the amount and nature of starch and protein in the raw materials. Their binding effect is modified by many other factors including the moisture content, fiber content, oil content and fineness of grinding of the raw materials. Various types of dies are available for dealing with different mixes. Instruments can be obtained for testing pellet hardness and resistance to abrasion.

FACTORS DETERMINING PELLET QUALITY:

Protein and density:

Ingredients with high natural protein will plasticize under heat, which will cause good quality pellets. Ingredients or feeds with high density have high production rates. If an ingredient or feed is both high in natural protein and density, the high production rates and good pellet quality can be expected. When low protein and high density are the factors, high production rates and poor pellet quality can be expected. At the other end of the spectrum, an ingredient or feed that has low protein and low density should produce a poor-quality pellet with a poor production rate.

Particle size

Particle size reduction results in a better-quality pellet and higher production rate because the steam penetrates the smaller particles through to the core, making them soft and pliable. However, the steam is unable to penetrate the larger particles completely, leaving the center dry. These large particles will cause cracks and fractures in pellets. The smaller particles will increase horsepower efficiency of the mill by increasing the throughput of material through the die holes with less horsepower. The finer grind also extends the die life as it decreases the “grinding” or milling of material on the solid land

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between the holes on the die face.

Fat

Fat content of ingredient or feed aids in increasing production rate but too much fat can affect pellet quality.

Fiber

High fiber reduces rate of production, as fiber is hard to compress into a pellet. But due to natural binders inherent to fiber, a good quality pellet is produced.

Texture

Fine or medium ground materials provide greater surface area for absorption of moisture from steam, resulting in better lubrication and increased production rates. Also, more particles are exposed to steam, resulting in possible chemical changes that may be needed for quality of pellet. Very coarse grinds or large particle sizes provide natural breaking points in pellets, creating more fines.

Starch:

High starch formulations are needed to produce energy dense feed which is required to fulfill nutritional need of high yielding dairy animals. High starch formulations or ingredients are difficult to produce a tough, durable pellet. The natural agglutinants can be activated only with high temperatures and moisture. The gelatinized material acts as a binder to produce the desired pellet quality.

Moisture

Sufficient inbound moisture added prior to pelleting can be desirable in reaching good pellet durability. A binder may be added to the feed if adequate pellet quality is not obtained through proper steam conditioning and die selection. Two of the most widely used are bentonite and lignin sulfonate.

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