CHAPTER-3

Grinding and mixing of feed ingredients

Objectives

1. To grind the feeds.
2. To mix the feed ingredients for making compound feeds.

Introduction

For making compound feed, grinding of different feed ingredients is the first step. Then the ingredients are mixed in fixed proportions for different categories of animals.

Grinding

It is a particle size reduction process which is the simplest and least expensive method for preparing feeds for livestock feeding. It is a prerequisite for mixing, pelleting etc. and it varies from fine to coarse. It is usually accompanied by hammer mill which reduces the particle size by means of impact grinding. Medium fine grinding is the best. Very fine grinding makes feeds dusty with lowered palatability resulting in poor animal performance.

Advantages of grinding

- ✓ Increases the particle numbers and thereby increases the surface area for better action of digestive enzymes in the rumen with enhanced digestibility and animal performance.
- ✓ Grinding results in better mixing of feed ingredients facilitating in better extrusion and pelleting.
- ✓ Segregation of particles is avoided.
- ✓ Selective feeding by livestock will be minimize.d or avoided. So wastage in feeding will be minimum.
- ✓ Palatability of ingredients will be improved. Energy loss due to mastication will be decreased. Feed passage time will be decreased. Feed consumption will be increased. But decreased feed passage time reduce the digestibility of fibre in ruminants since residence time in the rumen is less.

Mixing of ingredients

Small quantities of animal feed can be adequately mixed manually using shovels. The ground raw materials should be layered one above one another, and then mixed and turned to form one heap. Mixing of the heap at least 3 to 4 times may produce an acceptable product. Micro-ingredients such as vitamins, minerals, antibiotics, etc. are first mixed with diluents e.g. wheat bran and then it is added to ensure uniform mixing.

For mixing of large quantities of feeds, mechanical mixers such as vertical mixers, horizontal mixers are used for uniform mixing. The most important operation in a feed mill is mixing and this is the single operation that would be required in a plant to define it as a feed mill. The aim of mixing is to disperse the ingredients of a certain formula so that each small unit of the whole has the same proportion of each ingredient as in the original formula..

The addition of various liquids to feeds include molasses, vegetable and animal fats, fish solubles, phosphoric acid, choline chloride, etc. These are added to enhance palatability (e.g. molasses), energy (fats) and other nutrient content of the rations. However, addition of any liquid can complicate feed mixing operations. Special equipment for preheating and spraying of liquid are needed to avoid the agglomerate formation. Agglomerate formation can result in suboptimum microingredient distribution.

Liquids are preheated to reduce their viscosity. Molasses is preheated to 95 to l00°F while fat to 140 to 210°F. When liquids are added to the mixer, they should be sprayed over the entire lenghth of the mixer. Before doing so, allow the dry feed ingredients to mix for short time. This allows the microingredients to be dispersed throughout the moisture. The maximum amount of the molasses that can br successfully employed to the feeds is governed by the viscosity of molasses and by the absorptive quality of ingredients.

Microingredient Premixing

Premixes are formulations of one or more microingredients, such as vitamins, minerals, or drugs mixed with diluent and/ or carrier ingredient. Diluent and carrier should be inert and inactive. Premixes are used to facilitate uniform mixing of the microingredients in the complete feed or concentrate mixture.

Diluent is an edible substance used to mix with and reduce the concentration of nutrients and/or additives to make them more acceptable to animals, safer to use and more capable of being mixed uniformly in feed. The mixing properties of the original ingredients are not drasticaily altered. Carrier is an edible material to which ingredients are added to facilitate uniform incorporation of the latter into feeds. The active principles are absorbed, impregnated or coated into the edible material in such a way as to physically carry the active ingredient. When a carrier is used with a microingredient the mixing properties are

drastically altered.

Microingredients are nutritional adducts or drugs that are added to the feed at very low levels. Dispersion of such low concentrations of active ingredients presents a challenge to the manufacturers of the compound feed. This challenge can be met by the premix-the dilution of an active component with a suitable carrier.

Physical characteristics of microingredients such as particle size, particle shape, specific weight, hygroscopicity, susceptibility to electrostatic charges, adhesiveness of the particles due to physical properties, such as rough surfaces or additions of adhesives such as oils influence mixing them with the other feed ingredients. Microingredients have a very small particle size and high density compared to other feed ingredients. A significant uptake of moisture by a microingredient can seriously hamper its ability to distribute and mix well. A hygroscopic ingredient can affect the chemical stability of any moisture sensitive component. This problem may be dealt with during formulations by complexation or through a coating that acts as a moisture barrier.

Types of mixers

I. Vertical batch mixer

They may be single screw or double screw for elevating the material. However, single screw mixer is popular. These are relatively less expensive and little slower than horizontal mixers. These are not normally used in larger feed mills. It consists of a vertical bin tapering to a point at the bottom. A tube containing a vertical screw conveyor elevates and mixes the material as the mixer is filled. The screw conveyor continuously elevates the product and distributes it over the top of the mixer. Repeated elevation of· the product produces blending. Some mixers use two screw conveyors and few use other elevating devices. Normally screw is driven from the top but it can be driven from the bottom. These units range in capacity from 0.5 to 5 tonnes.

2. Horizontal mixer

This mixer is the most commonly used in larger feed mills. This mixer has right and left hand augers which conveys the material from one end of the mixer to the other while it is tumbled within the mixer. These mixers are equipped with openings at several places along the bottom to aid in more rapid discharge. The mixer shaft is accurately machined and mounted on bearings and is fitted with ribbons/paddles which thoroughly agitate and blend the ingredients to produce homogenous mix. The ribbon assembly /paddle is housed in a tub, the lower half of which is circular. Suitable speed reduction drive is provided to drive the mixer shaft at the designed speed to achieve proper mixing with or

without liquid additives. Other types of mixtures include double paddle horizontal mixers and ribbon blenders

Factors affecting mixing of ingredients

These include physical properties of solids (particle size, shape, density, coefficient of friction, resilience and electrostatic charge) and liquids (density and viscosity). Particle segregation, during or after mixing has been attributed to differences in physical properties of materials and the design of the mixer. A decrease in particle size is necessary to attain a sufficient number of particles for dispersion into each portion of feed. Where very small amount of microingredients are added, the required particle size is very small. The electrostatic properties, roughness of the mixer and cohesiveness are important factors that cause segregation when very small particles are mixed. Mixing time to achieve good distribution increase with very small particles. The rate of mixing is dependent on the properties of the materials being mixed as well as type of equipment used. Differences in the performance of mixing equipment are reduced when the materials have nearly the same particle size and density.

Sample questions

1. What is grinding and its advantages?
2. What are the types of mills used in grinding?
3. What is the process of mixing of feed ingredients at small scale?
5. What are the types of mixing machines?
5. What are the factors affecting mixing of feed ingredients?