



Design Consideration for Poultry Pellet Feed Plant Module of 200-300 Kg/H Capacity



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Introduction

In India, Poultry Feed constitutes nearly 60-70% of the recurring cost of the farm. Poultry feed is manufactured as per the feed formulae arrived based on nutrient recommendations for a particular category of poultry and feed composition. Nutrient recommendations published by Bureau of Indian Standards (BIS) (1994) are available as a guide for feed manufacturers in our country. These recommendations include margin of safety for certain nutrients. The technology of feed processing has undergone substantial improvement in recent years. It was only sixty years ago that feeds were mixed on the warehouse floor by the use of a shovel. Feed processing has progressed from the simple mixing of several ingredients by hand to mechanical mixing, to continuous mixing, and now to computer controlled mixing and pelleting.

However, the basic concept of mixing ingredients together to result in a nutritionally balanced feed has remained unchanged. To accomplish the mixing of different ingredients, grinding these ingredients to similar particle sizes, and then putting them together in a single unit, requires a considerable amount of specialized equipment and technical expertise. Some feed plants are designed for specific functions, such as making poultry feeds exclusively; others are designed for producing a variety of feeds.

Design Considerations

Pelletizing is a process of densifying/compacting finely ground material into a firm mass of the required shape and size by extruding it through a metallic ring die under optimum moisture, temperatures and pressure. The advantage of pelleting are, nutritional balanced feed, destruction of pathogenic organisms, thermal modification of starch and protein make more digestible, durable pellets reduce waste, reduce segregation, reduce selective feeding, improved palatability, allow larger meals to be eaten in less time, better material handling characteristics and customer satisfaction. Factors influencing pellet quality includes: formulation (40%), conditioning (20%), particle Size (20%), cooling (5%), die Specification (15%) and throughput. Factors that affect steam conditioning are: mash particle size (surface area increases geometrically as particle size decreases ($< 400\mu\text{m}$)), retention time

(30 to 90sec. for optimum pellet quality, paddle angle (retention time decreases as forward angle increases), shaft speed (15-20 rpm), water Addition (optimum conditioning at 16-18% moisture, with 4-5% moisture added by the conditioner, most common steam conditioning temperatures is 85-90°C). Considering the above the poultry pellet feed plant module of 200-300 kg/h capacity has been designed [1].

The main components of the feed mill plant modules are: Feeding Hopper, 1st Bucket elevator, Storage hopper, Screw Conveyor (feeder), Hammer mill, 2nd Bucket elevator, Stock hopper, Batch Mixer, Storage Hopper, Paddle conveyor, 3rd Bucket elevator, Storage hopper, Screw conveyor (feeder), Conditioners, Pallet Machine, Cooler air lock, Cooler, Crumbler, Blower, Cyclone, 4th elevator, Vibro screen, Finished goods hopper. The feeder is screw type and is equipped with a variable speed electric drive for speed control. The purpose of feeder is to provide constant, controlled and even flow of feed to the mixing and pelting operation. Screw Conveyor design steps includes, establishment of conveying requirements, identification of the material and the corresponding material code, determination of conveying size and capacity and speed, calculation of required horsepower- selection of motor size, determination of the recommended size of components, checking of the torsional ratings of components, checking of deflection, thermal expansion and abrasion etc.

For the selection of bucket elevator, the factors determined are, volumetric Capacity, Centers or Lift, lump Size and Lump Class, material Characteristics and operating Conditions etc. The material to be ground is subjected to the beating action of hammers until it is reduced to the fineness necessary to pass through the sieve of variable size openings. The beaters are made from mild steel (hardened). The continuous or "twin-spiral" mixer consists of a horizontal, stationary, half-cylinder with revolving helical ribbons placed on a central shaft so as to move materials from one end to the other as the shaft and ribbon rotate inside. Paddle conveyors are designed for conveying of materials. In a paddle conveyor, the paddles are fitted at regular intervals along the length of the shaft. Conditioning is accomplished by the addition of controlled amount

of steam. Addition of steam supplies moisture for lubrication, liberates natural oils and in some cases results in partial gelatinization of starches.

The conditioner considered is of paddle type conveyor. It is attached with steam inlet ports [2]. Steam with 50kg/h capacity, 5-6kg/cm² pressure is used for cooking with 90sec retention time (both the conditioner) raised the temperature up to 85-90 °C. Pellet Mill is required to palletise the feed after the steam cooking of the feed. Pellets are produced by squeezing the steam-cooked mash feed between the rotating die and pressing rolls. In pelleting unit the condition mash is forced through perforation in the die by roller pressure and gets compressed and forms into pellets. Adjustable knives cuts pellets into desired lengths. During crumbling, small pellets are broken between two corrugated rolls.

The set of powered corrugated rolls is usually placed directly below the cooler as this eliminates the need for an additional rate controller. It is made up of a heavy steel frame and housing. Purpose of cooler is to remove moisture and heat generated during the conditioning and pelleting process. The hot air is sucked by suction blower attached with cyclone. The pellet spread in two cooler beds for cooling. Cyclone separates dust. The fine dust gathers at the bottom of the cone and is extracted by rotary air lock. Blower remove the heat air from cooler. Vibro Screen has been designed to operate with special Vibro Motor imparting vibration in multiple direction to the screen assembly. Complete machine consists of Vibration generating base which houses the Vibro Motor and Screening Assembly with wire-mesh or perforated /slotted sheet.

The material fed on the screen travels above the screen or passes through the screen depending upon its particle size and nature. Here 3 sieves are in motion which separates over size, finished goods and dust particles. Fire tube type boiler is used of production of steam for conditioning operation. The boiler has the capacity of 150 kg/h and 5-6 kg/cm² pressure [3-6].

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