Available online at
http://currentagriculturetrends.vitalbiotech.org/

ISSN (E): 2583 – 1933

Curr. Agri.Tren.:e- Newsletter, (2023) *2*(11), 13-16

Current Agriculture Trends: e-Newsletter

Article ID: 246

Enhancing Seed Quality with Essential Seed Processing Equipment

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Article History
Received: 24. 10.2023
Revised: 29. 10.2023
Accepted: 5. 11.2023

INTRODUCTION

Seed processing involves various tasks, including the removal of foreign matter, ensuring uniformity for plantability, enhancing seed quality by eliminating damaged seeds, and applying seed treatments. The unit operations within seed processing encompass activities such as sorting, grading, conditioning, drying, cleaning, quality improvement, treatment application, packaging, and storage.

Stages in seed processing unit operations:

All the unit operations in seed processing are based on the physical characteristics of grains, including properties such as moisture content, true density, bulk density, specific gravity, color, size, shape, surface texture, length, and more. These grain properties play a key role in the design and development of seed processing equipment, which includes machinery like air screen cleaners, indent cylinder separators, specific gravity separators, magnetic separators, inclined drapers, spiral separators, and others. The sequence of these seed processing equipment should be thoughtfully arranged for optimal efficiency in obtaining the final seed product. The primary unit operations in seed processing encompass receiving the seed from the field, drying, pre-cleaning, conditioning, cleaning, separating, treating, weighing, bagging, storage, and ultimately, transportation or shipping.

Separation of seeds according to their physical characteristics:

Seed processors have access to a variety of seed processing equipment, each with its specific capacity. These machines are instrumental in eliminating undesirable materials that differ from the crop seeds in terms of size, length, shape, weight, affinity for liquids, surface texture, color, and electrical conductivity during the seed processing process.

Equipment for preliminary cleaning and preconditioning:

Pre-cleaners possess the distinctive capability of eliminating both lightweight, smaller crop seeds and larger particles. In contrast, pre-conditioning is a procedure employed to perform tasks such as the removal of lightweight foreign matter, shelling, and debearding, resulting in the preparation of seed batches for basic seed cleaning. This process also effectively eliminates larger undesired materials like pieces of debris, stones, clods, etc., from the threshed seed batches. With the advancement of mechanized agriculture, it has become necessary to integrate both of these operations, often in conjunction with shelling. Seed lots that have been hand-harvested and winnowed usually do not require pre-cleaning. Scalpers, debearders, huller-scarifier machines, and maize shellers are the most commonly utilized equipment for performing these operations.

Scalper/Rough Cleaner: Scalpers are simple devices comprising a vibrating or rotating screen or sieve designed specifically for the removal of larger debris. The screen openings are sized in a way that easily permits the passage of unprocessed seeds while effectively sifting out and separating the larger inert materials from the seed batch. Scalpers utilized in pre-cleaning processes may incorporate multiple screens or reels, sometimes combined with one or more controlled air separation mechanisms. Following the initial scalping or rough cleaning, the majority of seeds can undergo thorough cleaning without the need for additional pre-processing. However, certain crop seeds may necessitate additional procedures like hulling or scarification after the initial scalping.

Maize Sheller: Various types of maize shellers are accessible in the market, ranging in size from compact, hand-operated models to larger motor-driven machines with capacities reaching up to 10 tons per hour. The smaller hand-powered shellers are equipped with components designed to separate maize seeds from the entire cob. These components typically include a crank, a small feed inlet, a heavy cast iron flywheel, and a discharge for the cobs. When the machine is in operation, the seeds are collected at the bottom in a container, while the cobs are expelled from the rear. A perforated steel sheet is employed to create a concave surface that allows the seeds to pass through while retaining and redirecting the cobs toward a vibrating screen, leading to their discharge through an outlet. To ensure the shelled seeds emerging from the lower concave are free from small cob fragments and dust, an air blast is used to remove them.

Air screen cleaner: The air screen cleaner is an essential seed cleaning device that should be utilized before employing specific gravity or indent cylinder separators for seed cleaning. When choosing the appropriate size and type of air-screen cleaner for a specific operation, factors such as power requirements and the quantity and type of seeds to be processed should be taken into consideration. Some operations use a four-screen machine, which includes a first screen for rough scalping, a second screen for grading, a third screen for close scalping, and a fourth screen for fine grading. The top screen primarily serves for the initial rough scalping. The perforations on the first screen are sufficiently large to allow crop seeds to pass through while effectively removing larger foreign materials such as stems, twigs, sticks, dust, dirt, or weed seeds. Seeds that have passed through the first screen are collected on the second screen, which has perforations to eliminate trash, weed seeds, and smaller dirt particles than the crop seeds. The good seeds fall onto the third screen after traversing the perforations on the second screen. It's important to ensure that the second screen is consistently covered with seeds for higher efficiency and maximum capacity. The third screen usually acts as a close scalper, eliminating larger foreign materials or contaminating seeds that are small enough to otherwise pass through the first screen.

Disc Separator: A disc separator is a length-sizing apparatus designed to separate short seeds from a mixture of both short and long seeds. Initially, it was employed for the separation of wheat from other grains and seeds. In modern times, disc separators are widely used not only for separating various grains but also different seed types and granular materials based on their length. They are a common feature in most seed processing plants. The market offers a variety of disc separator sizes and types, allowing for the selection of a unit that aligns with specific requirements. For instance, a disc separator typically utilized in the trade of grass and vegetable seeds can be recommended for the effective cleaning of seed grains.

Indent cylinder separator: This equipment operates by separating seeds according to their length, specifically by lifting smaller or short particles from a seed mass. While the principle of separation in this device shares similarities with the disc separator, it is distinct in various other aspects.

Working principle: Seeds are introduced into the upper section of the rotating cylinder with the primary objective of cleaning. In this setup, all indents within the cylinder are of the same type and size, allowing them to lift particles of roughly similar sizes. As the indents traverse through the seed collection within the cylinder, shorter seeds or particles are deposited into the indents. These seeds remain lifted and secured within the indents until the force of gravity surpasses the centrifugal force, causing them to be released into the receiving trough. Subsequently, they are expelled from the machine via the receiving trough. The longer the seed, the farther it travels along the length of the cylinder. Finally, the seeds are discharged from the machine by passing them over a retarder into a hopper that effectively removes them from the apparatus.

Specific gravity separator: This apparatus essentially comprises a perforated deck that permits the passage of an airstream through it, onto which seeds are supplied. The adjustment of the airstream causes lighter seeds to be lifted, while heavier seeds remain on the surface of the deck. Subsequently, these stratified layers of seeds are separated, ensuring that seeds with different weights (lighter and heavier) move towards distinct outlets or spouts. This is achieved through the reciprocating motion of the horizontally oriented deck. The deck's surface is slightly inclined, enabling lighter seeds, supported by the air, to flow downhill and exit from the lower side of the deck, while the heavier seeds remain on the deck itself. The reciprocating motion of the deck results in the tossing of heavier seeds in an uphill direction with each movement. This motion continues until the majority of the heavier seeds are carried to the upper side of the deck, ready to be discharged through a separate outlet.

Specific gravity separator

Magnetic separator: In this apparatus, a small quantity of water or another liquid is introduced into the seed mixture within a mixing chamber. Within this chamber, every seed has the opportunity to absorb moisture, although some seeds may absorb moisture and become damp while others may not. Subsequently, finely ground iron powder is introduced and thoroughly blended with the seeds in the mixing chamber, ensuring that each seed has an equal opportunity to come into contact with the iron powder. The iron powder adheres solely to those seeds with a moist surface. Following this, the mixture of seeds is conveyed over a magnetized drum or cylinder. Only the seeds with iron powder adhering to their surface are attracted by the magnet.

CONCLUSION

Seed processing equipment is a fundamental component of modern agriculture, playing a pivotal role in the production of high-quality, uniform, and viable seeds. These machines and tools are essential for removing impurities, enhancing seed quality, and ensuring the uniform distribution of seeds for planting. The use of advanced seed processing equipment significantly contributes to increased crop yields, improved agricultural productivity, and sustainable farming practices. By investing in and utilizing the right equipment, farmers can access superior seeds, ultimately leading to enhanced food security and environmental sustainability. In conclusion, the importance of seed processing equipment in agriculture is undeniable, as it is a cornerstone of successful and efficient farming.