MECHANICAL SEED CLEANING AND HANDLING

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CONTENTS

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MECHANICAL SEED CLEANING AND HANDLING

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INTRODUCTION

Agriculture is the largest single industry in the world, and seed production is an important segment of this industry. Grass and legume seed production in the United States alone is valued at more than $250 million annually, and imports represent another $15 million. When the production of vegetable, grain, and flower seed is included, the total annual value climbs to $750 million. Seed is important not only as planting stock but also as a source of basic raw material for many manufacturing processes.

Seed, as it comes from the field, contains various contaminants like weed seeds, other crop seeds, and such inert material as stems, leaves, broken seed, and dirt. These contaminants must be removed, and the clean seed properly handled and stored to provide a high-quality planting seed that will increase farm production and supply uniform raw material for industry. The procedures used to meet present quality standards result in a loss of up to 50 percent of the good seed even though many special machines and techniques are used for seed cleaning and handling.

Attempts are being made to reduce seed losses by developing equipment and methods to improve efficiency in cleaning, treating, handling, and storing of seed. Although the research is concerned mainly with grass and small legume seeds, the techniques and equipment involved are generally applicable to all types of seed—forage, grain, vegetable, flower, tree, and industrial oil seed.

Manufacturers of seed machinery have done an outstanding job in developing processing equipment.[1] Some of the present seed-cleaning machines make extraordinary separations of small crop and weed seeds; however, the entire seed-cleaning problem is very complex, and improvements are still needed in methods and equipment to reduce the heavy seed losses.

This handbook was prepared as a guide in understanding, selecting, arranging, and operating seed processing equipment. Various types of seed cleaners and related machinery are described; principles of separation for both commercial and experimental developments are discussed; and basic concepts of seed handling, storage, and plant layout are presented.

There are many other related factors, not discussed here, which are important in any consideration of efficient seed production. Some of these are improved seed varieties, good cultural practices, effective seed harvesting techniques, accurate seed testing, and economic aspects of seed processing.

This publication is not intended to replace manufacturers' instruction manuals or the knowledge and experience of operators—rather, it is meant to supplement them.

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SEED CLEANERS AND SEPARATORS

Much seed cleaning is or should be done in the field before the crop is harvested. Good cultural practices like spray programs, crop rotation, and roguing can minimize many serious weed and contaminant problems.

When a seed lot enters the processing plant for cleaning, contaminants are removed by the use of special equipment that takes advantage of differences in physical characteristics of various components in the mixture. The chief

[1] A list of manufacturers of seed processing machinery is available by writing to the Agricultural Engineering Research Division, Agricultural Research Service, Beltsville, Md.

characteristics used in making separations are size, shape, density, surface texture, terminal velocity, electrical conductivity, color, and resilience.

Many types of seed-cleaning machines are available that exploit the above physical properties of seed, either singly or in some combination. There are air-screen cleaners, specific gravity separators, pneumatic separators, velvet rolls, spirals, indent cylinders, indent disks, magnetic separators, electrostatic separators, vibrator separators, and others. Of these, the most widely used machine is the air-screen unit; it is common to all seed-cleaning plants from the small farm operation to the largest commercial installation. All the other separators can be considered secondary machines which follow the air-screen unit in the processing sequence.

The choice of machines used and their arrangement in a processing line depends primarily on the seed being cleaned, the quantity of weed seeds and other contaminants in the mixture, and the purity requirements that must be met. Seed for planting is of little value unless it reaches the farmer in a viable condition, essentially free of contaminants, and at a price he can afford. The degree to which these requirements are satisfied is related to the equipment used, its arrangement in the processing plant, and the knowledge and skill of the man operating the machine.

Air-Screen Cleaner

The air-screen cleaner is the basic machine in a seed-cleaning plant. It makes seed separations mainly on the basis of three physical properties—size, shape, and density.

There are many makes, sizes, and models of air-screen cleaners ranging from the small, one-fan, single-screen machine to the large, multiple-fan, six- or eight-screen machine with several air columns. Screens are manufactured with many sizes and shapes of openings. There are more than 200 screen types available, and with a four-screen machine, more than 30 thousand screen combinations are possible.

The typical air-screen cleaner now found in a farm seed-cleaning plant is a four-screen machine located beneath a seed hopper, as shown in figures 1 and 2. Seed flows by gravity from the hopper into a feeder that meters the seed mixture into an airstream, which removes light, chaffy material so that the remaining seed can be distributed uniformly over the top screen. The top screen scalps or removes large material, the second screen grades or sizes the seed, the third screen scalps the seed more closely, and the fourth screen performs a final grading. The finely graded seed is then passed through an airstream, which drops the plump, heavy seed, but lifts and blows light seed and chaff into the trash bin.

The arrangement described above uses two screens as top screens and two as bottom screens. Other arrangements possible with a four-screen machine are three top and one bottom, or one top and three bottom.

Screen Numbering System

The size of a round-hole screen is indicated by the diameter of its perforations. Perforations larger than 5½/64ths of an inch are measured in 64ths. Therefore, a 1-inch round-hole screen is called a No. 64, a ½-inch screen is a No. 32, and so forth. Screens smaller than 5½/64ths of an inch are measured in fractions of an inch. Therefore, the next size smaller than 5½ is 1/12th; then, in descending order, 1/13th, 1/14th, and so forth.[2]

The smallest round-hole perforation commonly used in air-screen machines is a 1/25th which has a hole diameter of 0.040 inch. However, for special cleaning requirements, round-hole screen in smaller sizes (down to 0.016 inch) can be obtained from manufacturers of perforated metal. These special screens use a different numbering system and must be mounted on frames to fit air-screen machines. Swedish and other foreign manufacturers use the metric system in designating sizes of screen openings.

Oblong-hole screens are measured in the same manner as round-hole screens except that two dimensions must be given. In large oblong-hole or slotted screens, the hole width is indicated in 64ths of an inch; for example, 11 x ¾ means an opening 11/64ths of an inch wide and ¾ths of an inch long. In slotted screens smaller than 5½/64 x ¾, width is generally indicated in fractions of an inch; for example, 1/12 x ½. There are some exceptions to this latter designation in that such sizes as 5/64 x ¾, 4⅞/64 x ¾, 3/64 x 5/16, and others, use the large-screen numbering system with hole widths indicated in 64ths of an inch. In all cases, the final number is the length of slot.

[2] A table of decimal equivalents for various designations of round holes in screens is shown in the Appendix. This table is useful in comparing hole sizes of screens with different number designations.