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### Fundamental of Seed Processing

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FUNDAMENTALS OF SEED PROCESSING<sup>1/</sup>A. H. Boyd<sup>2/</sup>

Millions of years ago the first men to roam our earth had no need for a knowledge of agriculture. He was few in number and had vast areas of unspoiled territory in which to roam and gather his food. He had probably discovered that he could eat parts of some plants when meat was scarce. The most significant discovery of the ages was when one of these early humans noticed that the seed from his favorite food plants could be dropped in the soil and he could come back later and find the same kind of plant growing more food. This allowed him to establish permanent settlements and support an ever increasing population. Now over half the people who have ever lived on our globe are alive today! Our seacoasts are teeming with ships and our cities are busy attending to the business of our internal and world wide commerce.

Where do we as seedsmen fit into this picture of ever-increasing population? Millions of people get hungry three times a day. Those are the lucky ones. Many are always hungry. To supply the huge amounts of food and fiber for our people, our fields are a far cry from the small food patches of the early farmers. Grain moves to market through modern high speed grain elevators to be stored and shipped as needed. Other commodities are moved through equally efficient channels. To supply a basic ingredient, seed, for such a system, it is our charge to supply high quality seed of the needed kinds and varieties in sufficient quantities at a reasonable price. To do this we must not only have good efficient equipment. We must know how to operate it.

Let us now pull our chairs up around the conference table and discuss some of the fundamentals of seed processing. First, let's identify the basic problems in operating a processing plant.

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1. The most complete cleaning job that is practical.
2. Mixture prevention through good design and careful operation.
3. Good records for complete identity.
4. Use of these records for evaluation and improvement.

Since time is limited we will spend most of our time on the principles and machines used to attack the first part of the problem.

### PHYSICAL PROPERTIES OF SEED

To successfully clean a lot of seed we must analyze the sample to see what physical characteristics of the seed and/or other materials present can be used to accomplish a separation. Next we must know which machine will do that job and how much to expect from it.

#### Size:

The first physical characteristic to think about is size. The air-screen machine and the width and thickness graders such as the precision grader and the Rock-it separate according to size.

The air-screen machine is the basic and often the only machine used in seed cleaning. A modern air-screen machine shown on the slide has two air systems and five screens. The top air will be used to lift the very light chaff and dust as the seed flow from the feed hopper. The top screen is called the top scalper and is usually a large round hold screen to remove only the large trash and long stems. The seeds drop through to the first grading screen which has the smallest openings of any of the screens used and drops only the small seed out. The seeds going over the first grading screen are fed onto the second scalping screen which has smaller openings than the first scalper and removes anything which is slightly larger than the good seed. The material which drops through the second scalper goes to the second grading screen which has slightly larger openings than the first grading screen and removes seeds which are smaller than the good seeds. Next the third grading screen has openings only slightly smaller than the good seed and is the final screen before the good seed pass across the bottom air

which is set to remove lighter immature seed and light particles of foreign material which may still be present.

Some things which may help you operate your air-screen machine more efficiently are:

1. Attaching an oil cloth, slick side down, so that it holds long seed or straw flat on a top screen preventing them from turning on end and falling through with short seeds.
2. Placing strips of wood or sash cord across screens to form screen dams to hold seed on a screen longer and allow a better chance for a more complete separation.
3. Installation of clay crushing rolls to break up pieces of clay but not damage seed so that screens and air can remove the soil.
4. Using the tilt of the shoe to control the rate of movement of seed through the machine. The rate of vibration should only be adjusted to keep the material "live" on the screens.

After basic cleaning the precision grader can be used for some very close separations of contaminants and for width and thickness grading of corn. The precision grader uses a rotating shell and baffles to tumble the seed so that they will present the proper sides for grading.

#### Length:

The air-screen machine is not capable of all separations necessary in seed processing. Where it fails we must go on to other, more specialized machines. The next property is length. The indent cylinder and the disc separator separate seeds by length.

Here is an example of peas, vetch, and oats. You will notice that all the seeds are the same width but the oats are, of course, much longer. The pockets on the face of a disc are cut out so that a short seed can sit in the pocket and be lifted out of the mass of seeds, but a longer seed will overbalance and fall back into the mass. To gain capacity many discs are mounted on one shaft. The mass of

of seeds is fed into one end of the machine and small paddles on the hub of each disc propel the seed toward the other end. As the seed are flowing through the machine the discs have the opportunity to lift out the short materials. Discs are made in many sizes for specific separations.

The cylinder separator is a length separator which uses centrifugal force and indents on the inside of the cylinder to accomplish a separation. Seed is fed into one end of a revolving cylinder until a bed of seed is built up. The rotation of the cylinder tumbles the seed bed giving all the seeds an opportunity to fit into one of the indents. Shorter seeds are held in the indents longer as the cylinder rotates and an adjustable trough catches the highest lifted seeds and conveys them down the center of the machine. By varying speed of rotation, position of the leading edge of the trough and varying the indent (by changing the cylinder) an excellent job of length grading is possible. It should be pointed out here that the cylinder does its best on materials having a weight per bushel of 45 pounds or over. On light and chaffy seed the disc should be chosen.

#### Shape:

Many things are recognized by their shape. To separate seed by differences in shape we use a spiral separator or draper. The length graders and air-screen machine also separate by shape to some extent. Consider this illustration of soybeans and giant morning glory seed or moon flower. The soybeans are almost spherical while the moon flower seeds have two flat sides much like the sections of an orange. If these seed are allowed to roll down an inclined plane the soybeans will gain much more speed. If the plane is curved the faster seed will move to the outside of the curve. This is the basis for the spiral separator. The faster moving seed jump off the inner spiral into an outer spiral and the slower seed remain on the inner spiral and slide down into a separate chute.

The draper belt takes advantage of these same characteristics. It consists of an inclined canvas or plastic belt which moves up hill. The round or smooth seed roll off the bottom and the flat or rough seed are carried over the top.

### Weight:

It is easy to classify many things by weight. Seed too, are often separated on the basis of weight or specific gravity. To do this we can use the pneumatic separator, aspirator, gravity table, or stoner.

Here is an example of wheat with insect damaged seeds. This would be obvious separation by weight. One way to do this is with the pneumatic separator. The pneumatic separator consists of a fan blowing a column of air through a tube. The seed are fed through a chute across this column of air where the lighter "rejects" are blown upward into a collector cone and the heavier material flows across into its chute.

The aspirator also uses air for its separation but it operates on vacuum rather than pressure. This is the basic difference between an aspirator and a pneumatic separator.

The gravity table is one of the most useful and misused machines in our processing plants. Gravity tables make separations by weight or specific gravity through use of a tilted oscillating deck with a perforated cover. This deck varies in degree of roughness and size of perforations depending on the size and kind of seed to be separated. Deck materials range from cloth for clovers to rough screen wire for corn and cotton seed. Fans furnish a positive air pressure in an air chest beneath this deck. By adjusting the air pressure seed fed onto the deck are lifted slightly so that the lighter seed do not sit as firmly on the deck as do the heavier seed. The pitching motion of the deck then tends to kick the heavier seed uphill on the deck with each upward stroke.

The stratification of the varying weights caused by the lifting effect of the air and the action of deck allows the lighter seed to tumble to the low side of the deck. End tilt causes the separated seed to work their way off the lower end of the deck as seed are fed onto the upper end. The separation needed is selected by the divider location at the end of the deck.

Some of the common mistakes gravity table operators make are:

1. Machine installed on a weak foundation.
2. Blowers running backwards.
3. Operating with excess air.
4. Operating with insufficient air.
5. Attempting to separate materials not suitable for gravity separation.
6. Using the wrong deck.
7. Trying for capacity before obtaining an efficient separation.
8. Air not clean.
9. Belts slipping.
10. Covers over air filters not removed.
11. Irregular feed.

The gravity can be expected to:

1. Separate materials of the same size but differing in specific gravity.
2. Separate materials of the same specific gravity but varying in size.

The gravity table will not separate materials varying in size and specific gravity. An example of this would be wheat and oats. In such a case you would get a small fraction of heavy wheat, a small fraction of light oats and a large meddling product consisting of essentially what you started with.

A variation of a gravity table is the stoner. It was developed, as the name suggests, to remove stones from seed. It gives more capacity for the horsepower and dollar expended but has the disadvantage of making only a "yes or no" separation.

#### Surface texture:

Another physical characteristic we can exploit to make separations is the surface texture of the seed. The roll mill is the most used machine in this category. It consists of contrarotating velvet covered rolls. The seed to be separated are fed onto one end of the rolls, and as they work their way down between the rolls the

nap of the velvet catches the rougher seed and tosses them over the side. The smoother seed are relatively unaffected and continue on down the rolls and are fed into a chute at the end. An adjustable curved shield is located over the rolls so that rough seed tossed into the air can be deflected over the side. Adjustments of the roll mill include: speed of rotation of the rolls, tilt of the machine and clearance of the shield.

The draper separates on seed coat texture in the same manner as it does for shape.

#### Color:

Color is a character which is increasingly used in seed processing. The electric color sorter does this job for us.

This basic unit of the electric color sorter is the photoelectric cell which changes its electrical characteristics in proportion to the light which strikes it. By positioning light filters in front of the photoelectric cells they can be made sensitive to color as well as brightness. One type of electric color sorter feeds the seed from a vibrator to a U-shaped belt which conveys them off the end of the belt where they fall free through the optic box. Here they are scanned, classified, and if rejected a jet of compressed air kicks the rejected seed into a separate chute. If they are accepted they are allowed to continue on their trajectory into an "accept" chute. Another type does essentially the same job but to gain capacity and precision the seed are fed into a spinning bowl where they are picked up on the ferrules of a drum by vacuum and conveyed through the optic box for scanning and classification. An air ejector is mounted inside the drum to reject any of the seed which are graded as "reject" by the machine. Even though the color sorters are comparatively expensive they are extremely versatile and seedsmen are finding increasing uses for them.

#### Affinity for Liquids:

Some seeds have a greater affinity for liquids than others. The magnetic separator and buckhorn machine use this principle for their separations. The magnetic separator consists basically of a seed feeder, water spray, iron powder supply, mixing chamber and a magnetized drum. The seed with a greater affinity for water become wet and sticky and therefore, adhere to the iron filings. Then



as the seed flow over the magnetized drum, the magnets attract the iron filings causing the seed to be held close to the drum and fall behind a divider while seed with no filings attached drop off readily into the main flow.

The buckhorn machine works on the same principle except that fine sawdust instead of iron filings is fed into the mixing chamber. This machine was developed to remove buckhorn plantain from clovers. The seed of buckhorn plantain become sticky when moistened and adhere to the sawdust. The mass of seed is then cleaned on an air screen machine. In effect you have changed the size of the buckhorn seed so that it may be separated by another machine.

#### Conductivity:

The conductivity of seed vary and the electrostatic separator uses this principle. This machine was developed for the mining industry to process low grade ore and adapted for some uses in the seed and milling industries. It uses a highly charged electrode and a grounded roller. The seed which readily conduct electricity are relatively unaffected and drop off the roll while some of the seed hold the charge placed on them by the field and are "pinned" to the roller and carried under the roll. This machine has much potential but due to its sensitivity to relative humidity and other factors it is not often used in seed processing.

### SUMMARY

In summary let us then say seed can be separated on the basis of their:

1. Size
2. Length
3. Shape
4. Weight
5. Surface texture
6. Color
7. Affinity for liquids
8. Conductivity

Now we come to two of the most important tools available to the processing plant operator. They are the scoop and the broom. No matter how good your processing plant is, if you don't keep it clean you cannot expect to prevent mixtures.

When you sell a bag of seed you should be able to tell your customer with confidence that you know what is in your bag. To do this a good set of records is necessary. Your records should give you complete identification of a lot and include information on receiving, drying, processing, packaging, testing, storage, inventory, and sales.