Air and Screen Cleaners

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Our subject is AIR AND SCREEN CLEANERS. Although there are many here who have a complete knowledge of these machines, let's think together for a few minutes about (1) WHAT THESE MACHINES ARE, (2) WHY THEY ARE USED and what can be accomplished with them, (3) WHEN AND WHERE THEY ARE USED, and (4) HOW TO USE THEM.

If you "picture in your mind's eye" a flat perforated screen 3 or 4 feet wide and 4 or 5 feet long, with one end a little higher than the other, you will have an idea of part of the basic design of these machines. If seed is fed onto the high end of the screen while the screen is vibrated or shaken back and forth, the seed will flow toward the lower end of the screen. If the holes in the screen are just large enough to let the seed fall through, any larger material mixed with the seed will pass over the screen and fall off at the low end.

We all know what wheat looks like, so suppose we put some wheat on this screen, and we'll use a screen that has round holes about a quarter of an inch in diameter - just a little smaller than an ordinary lead pencil. Let's shake this screen and see what we have coming through and going off the end. Off the low end, we have pieces of straw, empty hulls, some thistle heads, large swollen kernels and some kernels that were not completely threshed from their hull during harvest. How we'll look at the wheat that went through the screen. Here we see with the good wheat small round weed seeds, some long thin weed seeds, some dirt, light chaff, pieces of empty hull and wheat that was split or cross broken by the combine during harvest.

Now let's take another screen, one that has oblong or slotted holes a little wider than one sixteenth of an inch and about a half inch long. We'll put the wheat that went through the first screen on this screen and see what happens. Over the low end of the screen goes the good wheat, empty hulls, cross-broken kernels, and some round weed seeds. The material that went through the screen consists of long thin weeds seeds, split wheat, some dirt, chaff and hull particles.

If we put the wheat on a screen having round holes about one eighth of an inch in diameter we can drop the cross-broken kernels and the round weed seeds that would not go through the slotted screen.

1/ Mr. Frevert was associated with the Crippen Manuf. Co., Inc., manufacturers of grain, bean and seed cleaners, separators, scalpers, graders, and polishers. He passed away in 1980.
We still have some empty hulls with our wheat and some lighter weight kernels that are the same size as our good heavier wheat.

Now let's imagine a controlled stream of air passing upward through the wheat just before it falls onto our first screen. This air will draw out the chaff and other light material from the wheat before it gets to the screens, so the screens will be free to do a better screening job.

We have now screened from our wheat the larger and smaller material that was in the original mixture, and with air we have removed the lighter inert material before it got to the screens, so we have a product that is quite uniform in size and general appearance; but we still have some kernels of wheat that are lighter in weight than the others although they are the same size.

These lighter kernels are usually lower in germination and also cut down on the final test weight. So, to remove them from our final product we will put another controlled air separation AFTER the screening operations. This air will also remove any remaining light foreign material that was not removed by the screens, or was a little too heavy for our first air separation.

This is but one simple example of how screens and air can be used to clean and grade the hundreds of different kinds of seeds that are grown throughout the world.

What we have been doing here is making separations by air-lifting out material lighter than our product - and also making separations by the DIFFERENCE in the shape of the seed compared to the material we wish to remove from the seed.

If nature had provided us with useful seeds that could be harvested with only chaff and larger and smaller material to be separated from this good seed, I doubt very much if any of us would need to be here today at this short course on Seed Processing. Our problems of cleaning and grading would be quite simple: we could harvest our seed crops and with a few screens and a little wind we could soon have them ready for market or replanting. But such is not the case, today our seed comes to the processor with large percentages of inert and foreign material because of growing and harvesting methods. Our equipment must be more specialized now than a few years ago in order to meet the ever-tightening grade requirements and the demands for more pure seed and higher germination.

The air and screen cleaners are the basic and primary machines of the seed processing trade because they are not limited to one kind of separation. More than 200 different sizes and shapes of screen openings are available to clean and grade our seeds. Seeds can go either THROUGH or OVER these screens in order to make separations by the DIFFERENCE in
width, thickness, general shape, and in some cases differences in length and surface coatings. In general cleaning operations, these differences are between the product we are after, and the impurities that come in with the seed such as inert matter, dirt and weed seeds. In other processing operations these differences are in the grades or classifications necessary for marketing or for further processing on other types of equipment such as disc and cylinder length separations, gravity tables or roll machines.

Screens are available in perforated metal with holes that are round, slotted, oval, triangle, and also some indented shapes, ranging in sizes from 1/25 of an inch which is equal to only 40 thousands of an inch, up to well over 1 inch in size. Round hole screens are usually designated as near as possible by numbers which are in 64ths of an inch and in halves of 64ths. Sizes that do not come in 64ths are such fractions of an inch as 1/15, 1/17, or 1/22nd. Slotted or oblong screens come in the 2 dimensions of width and length such as 4 by 1/4, 1/18 by 1/2 or 10 by 3/4. Triangle perforations are designated in 2 systems, one being the length of the sides of the triangle in 64ths such as 8/64 or 10/64. The other method is designated in V numbers such as 5V, 5 1/2 V, 6V, etc. These V numbers are the diameter of a round gauge, in 64ths of an inch, that will fit inside of the triangle and touch each of its 3 sides. In other words, the diameter of a circle inclosed within the triangle, is designated in 64ths of an inch.

Wire mesh screens are available with openings that are square or oblong. They are numbered in OPENINGS PER INCH such as 24 by 24, and 30 by 30 in the square meshes, and range from very coarse to as fine as 60 by 60. Oblong mesh openings come in consecutive sizes such as 2 by 10, 3 by 14 or 4 x 20 and even as fine as 6 by 60 openings per inch.

With so many screens available, one can easily imagine the great many separations that can be made with this type of machine. And when we add air separations to make divisions by weight and shape, it greatly increases their usefulness.

When the main flow of seed goes through a screen to remove larger material, the screen is called a SCALPER or a TOP SCREEN, and sometimes a "riddle". Most cleaners nowadays have a second or CLOSER SCALPER which is sometimes called a MAIN SCREEN. The first scalper relieves the second scalper of much of the coarser material, and a smaller screen opening or a different shape is used for the second scalper. An example of this would be a first screen of 1/14" round for Clover and a slotted screen of 3/64 by 5/16" for the second screen, each removing a different line of material.

When the main flow of seed goes OVER a screen, letting smaller material fall through such as weed seeds, dirt, or smaller seeds, that screen is usually called a BOTTOM SCREEN, A GRADING SCREEN OR THE "SEED SCREEN."
Generally, although there are some exceptions, round screens are used as a top screen for round seeds such as beans, peas, or clover. Slotted top screens are used for longer seeds such as brome, fescue or oats. Bottom screens used to remove long and thin seeds, and immature or split seeds, would be of oblong or slotted shape. If the smaller material consists of sand or dirt, and round seeded seeds, then a bottom screen with round holes would be used. When cleaning small seeds such as the clovers or grasses, the bottom screens would be of wire, either square or oblong mesh.

Lists of suggested screen sizes for cleaning and grading seeds are available from the manufacturers of these machines, and are also published in articles and literature on seed cleaning and processing.

Various methods are used to keep the screen openings from becoming plugged with material or seed that might lodge in the holes. Nearly all modern machines have brushes under the screens which travel back and forth to keep the holes open. Screen tappers are often used on top of screens to keep material loose so the brushes can remove it easier and faster. Rollers or flat wipers are sometimes used under screens instead of brushes.

A machine having top and bottom screen positions could be considered as the basic design for larger cleaners which have multiple screen positions to eliminate re-running the seed through a 2-screen machine. Machines with 4-screen positions are usually built so that 2 screens can be used for top or scalping operations, as explained previously, and the other 2 screens for bottom work. The advantage of having 2 bottom screen positions is so that 2 different shapes or sizes of screens can be used, one behind the other for different purposes. The first bottom screen could be used to let through sand and small weed seeds, and the second bottom screen of different shape or size would drop out material that would not go through the first bottom screen, such as immature seeds and different kinds of weed seeds.

Some screens and air machines are built with screen positions that can be used for either top or bottom work. This versatile screen position can be used as an extra top operation that is useful on many commodities like the grass seeds that have a large percentage of trash to be scalped out. The same screen position when used as a third bottom screen will often eliminate an extra re-run over another machine. Another advantage of this type of machine is for grading purposes where different classifications of the cleaned produce are desired, such as first and second grades, or for separations of seed corn shapes. The number of useful screen positions in this type of machine should be determined by the number of separations desired and the type of work to be accomplished. Machines with 5 and 7 screen positions are in operation in some seed plants.
Some machines have screens that are adjustable for pitch so the commodity can be held longer on the screens or run off faster. Generally, the top screens are kept flatter because the product is going through, while the bottom screens have more pitch because the main flow is going over them.

Variable speed of screen shake is important because the operator can adjust the speed of screen vibration to make separations that are not possible with a fixed speed. Seed flowing on a screen that vibrates too slowly will not have enough mixing action to cause each seed to fit itself to holes in the screen. EACH SEED must get to the holes in the screens to determine if it should go through or stay on top, for after all, that's the main reason screens are used! If the screen vibrates too fast or has too much pitch, round seeds such as beans, peas, vetch, etc. will bounce on the screens and accuracy of separation is lost. The best speed is one that causes the seed to ripple and mix well as it flows evenly down the screens. Moisture content, kinds and percentages of foreign material, and the general condition of the seed will all affect the flow, and a fixed rule for the speed of screen vibration is difficult to establish. With a little experience and close observation of the separations, the operator will soon be able to set his machine for the most efficient screening speed. These controls are easy to adjust while the machine is in operation.

To obtain maximum capacity and uniform separations, it is important that a constant and even flow of seed be fed through the air separation systems and to the screens.

Different types of feeding hoppers are available so the commodity can be fed evenly through the machine.

If the mixtures of seed coming to the cleaner would always be uniform in general condition, the operator might be able to adjust his air separations and forget them. But incoming seed will vary from one bag to another, in the same bulk load, or from the same field. Seed that is combined in the morning may contain more moisture and a different class of inert material, than seed that is combined in the afternoon when the sun has been shining on it all day. Therefore, the best operators will frequently look at their separations to see if more or less air should be used, and then adjust their machines to take out as much waste as possible without loss of good seed.

Some machines are built with an air separation only at the feeding hopper. They are built this way to remove as much light trash and dust as possible before the screening operations. This type of machine sometimes carries only one scalping screen, but more often they are built with top and bottom screens. Usually called "SCALPERS", they are useful as "pre-cleaners" to relieve the other machines in the seed plant of much of the dirt and trash that comes in with the seed.
Some cleaners are built with only one air separation following the screening operation at the discharge end of the machine. Usually they are built with just a blower type fan, and require comparatively low horsepower. This type of cleaner is useful on many cleaning operations and is often used for specialized or "custom cleaning."

With some exceptions, the most desirable screen and air machines will have air at the feeding hopper to relieve the screens of as much trash as possible, and then another air separation after the product has been brought to uniform size by the screening system - to increase test weight and purity. Some cleaners are built with independent air separations at 3 different places in the machines - to obtain greater accuracy and more volume, or for making two grades of the finished product in one run through the machine.

The location of screen and air machines in the plant is usually ahead of other processing equipment, so a more uniform product can be fed to these other machines such as the "pocketmachines," gravity tables, etc. We should think of our different kinds of machines as various tools and learn their uses and limitations - just as a machinist must use drill presses, lathes, and milling machines for different purposes.

You may have heard the following statements before, but I believe they are worth repeating: (1) inspect the separations and the finished product coming from your machines, frequently, and adjust the machines accordingly - because the seed coming to them does not always run uniform in the material that must be removed; (2) use as much air as possible without removing too much good seed; (3) keep your top screens as small as possible without carrying over good seed; and (4) keep your bottom screens as large as possible without letting good seed drop through.