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Basic Seed Conditioning

V. Harden

BASIC SEED CONDITIONING

Virgil Harden[1]

When one hears the phrase "*Basic Seed Conditioning,*" what immediately comes to mind is the process of removing all undesirable contaminants from the seed mass. Just as important, however, and sometimes overlooked are prevention of varietal mixing and unnecessary mechanical damage.

Receiving

Provided the seeds brought to the cleaning plant are of seed quality, *Basic Seed Conditioning* begins with the receiving operation. The receiving pit should be of such design as to prevent mechanical damage or germination damage and/or varietal mixing of seeds.

Gravity-flow receiving pits are the best type to use for the receiving of seeds. However, gravity-flow pits have to be very deep when designed to hold large quantities of seeds and are the most costly to install.

The most frequently used types of receiving pits for receiving of seeds incorporate vibrating shaker spouts, belt conveyors or drag conveyors in the bottom to transfer seeds to the boot inlet of the receiving elevator(s). Also, the receiving pit grill should not have ledges, cracks or crevices to hold pockets of seeds which would cause varietal mixing and extend clean-up time between receiving of different varieties.

When truck trailers are dumped, "splashing" of seeds sometimes occurs and large amounts of seeds bounce out of the pit and onto the surrounding area around the pit opening. Large pit openings assist in eliminating this type of "splashing" effect which in turn reduces the amounts of time one must spend in pit clean-up between receiving of different varieties.

Receiving bucket elevators for seed plants should be the type especially designed for the gentle handling of seeds. Seed elevators have large diameter head pulleys

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and slow belt speeds which discharge the seeds from the elevator cups directly into the throat of the elevator (Figure 1). Legs on the elevator boot at least four inches in height allow additional room for cleaning between varieties. Nylon spacer washers about 1/2 inch thick placed between the elevator cups and belt give the proper space to prevent seeds from lodging behind the cups (Figure 2).

Only one receiving elevator is needed if no bulk storage is incorporated in the seed conditioning facility as the only place to spout from the elevator is to the seed cleaning plant itself. However, if bulk storage is incorporated into the seed conditioning facility, then it is recommended that two receiving elevators be used in the receiving pit.

Two receiving elevators provide much more flexibility in that they allow more than one function to be performed at a given time. For instance, with two receiving elevators the seedsman may:

- Receive two varieties of seeds simultaneously without having to clean out the elevator boots.
- Receive into a pre-cleaner, then spout the seeds directly to bulk storage or to the seed cleaning plant.
- Receive through the receiving pit for routing to bulk storage bins while at the same time transferring seeds from another storage bin to the seed cleaning plant.

When using two receiving elevators, spouts from both elevators need to be to all points so that in case of mechanical failure of one elevator, the other can be used without a loss of receiving time.

A primary source of varietal mixing can be eliminated by using seed-type distributors which have internal locking spouts or leak-proof bucket valves if an elevator is to be spouted to more than one point.

Precleaning

Precleaning seeds prior to bulk storage is advisable as this process eliminates a large portion of undesirable foreign contaminants making for better conditions under which to store and/or dry seeds in bulk tanks or bins. Precleaning also enhances the actual precision cleaning process because the major portion of unwanted foreign contaminants have already been removed from the seed mass.

Two different types of precleaners are primarily used in seed conditioning plants: the reel type which uses a revolving wire mesh cylinder to scalp off the larger sticks, stems and straw; and the reciprocating screen type which uses both a

Clipper ELEVATOR HEAD SPEEDS

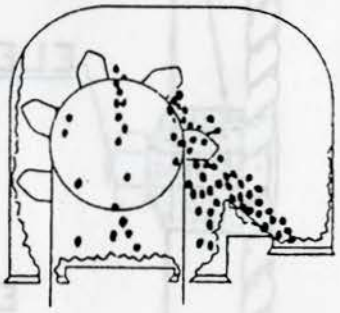
Clipper heads, boots and legging are products of intensive study involving thorough engineering and precise construction. A bucket elevator, properly designed, driven at correct speed, will make a clean discharge directly into the throat assuring no appreciable damage on vulnerable commodities and little or no backlegging or downlegging.

Note: A slight deviation such as 5 r.p.m. above ore below optimum speed causes the cups to spill or throw.

Sketches below illustrate commodity discharge patterns of a 24-inch diameter pulley at: TOO SLOW - 35 r.p.m., OPTIMUM - 45 r.p.m. and TOO FAST - 65 r.p.m.

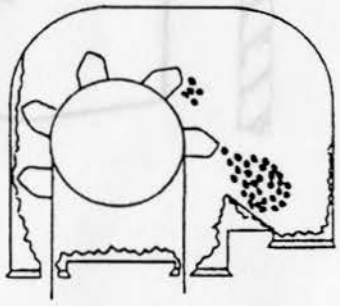
TOO SLOW - spillage

Cups spill the product into the upleg and downleg. Breakage occurs when the kernels strike the cups ahead, when tumbled within the pulley and when re-elevated.



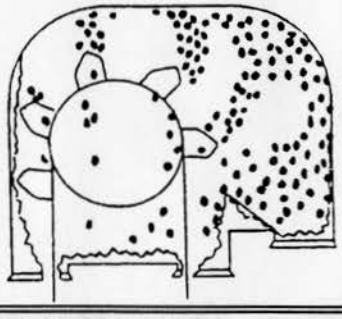
OPTIMUM - recommended speed

Cups fill and carry perfectly, then discharge directly into the throat -- no spillage -- no breakage.



TOO FAST - critical when commodities are damageable by rough or fast handling.

Cups lose all holding and discharge control, resulting in gross inefficiency, excessive breakage and undue head wear of the head liner.



OPTIMUM SPEED CHART														
Pulley Dia.	12	16	18	20	22	24	26	30	32	36	42	48	60	72
R.P.M.	60	55	52	49	47	45	43	40	38	37	34	32	28	26

Figure 1. Some characteristics and criteria for belt-bucket elevators used for seeds (*Clipper* type).

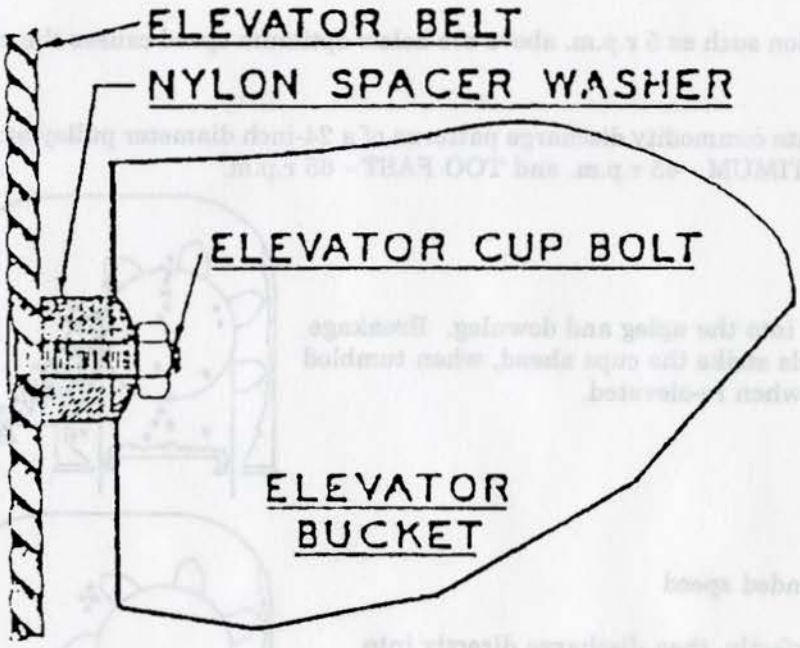


Figure 2. Spacer washers between bucket and belt - a must in a seed conditioning plant.

scalper screen and a sifting screen to remove both large and small contaminants. As the reel type scalper has no bottom screen for removing small participles, it is used as a scalper only. Both the reel type scalper and reciprocating type precleaners can be equipped with an air separation for removing dust and very fine particles. Although the reciprocating type precleaner would be the best choice under most conditions, the seeds you plan to preclean may be a determining factor as to which type unit is required. For example, if a seedsman is cleaning soybeans, wheat and rice in his facility, the reciprocating type precleaner would be the choice for both soybeans and wheat. However, if the rice coming from the field has a high enough moisture content as to prevent the rice kernels from sliding down perforated metal screens, then the reel type scalper would be the better selection if only one precleaner is to be used. Do not misunderstand my reason for selecting the reel type precleaner. A reciprocating precleaner having a capacity of 4,000 bushels per hour on soybeans and wheat would only have a capacity of about 1,500 bushels per hour on paddey (high moisture) rice. The reduction in capacity for that portion of rice precleaning is my reason for selecting the reel type precleaner for all products: soybeans, wheat and rice in this situation.

The most economical way in which to design a precleaner into a seed cleaning facility is to use a high capacity precision cleaner for the actual cleaning process. Then by using larger openings in the top scalping screens and smaller perforations in the bottom sifting screens, a higher precleaning capacity may be obtained. The clean seed discharge from the high capacity cleaner must be bi-directional, both to the bulk storage system and to the final cleaning process within the cleaning plant. This method would reduce the flexibility of the total facility in that the seedsman would not be able to preclean received seeds and precision clean in his plant simultaneously.

The only disadvantage of a precleaning system is the down time required to clean up the precleaner when more than one variety is being received in alternating loads. A seedsman may choose to program his receiving equipment so that the larger quality of variety being received passes through the precleaning process with the lesser amount going straight to bulk storage, by-passing precleaning at the time of receiving. Seeds by-passing precleaning at time of receiving may then be precleaned at a later date.

Bulk Storage

Bulk storage bins are available in many shapes and sizes with each type having its own particular advantage over others. Flat bottom bins are the most economical to install and allow in-bin drying should moisture need to be removed from seeds.

Hopper bottom bins eliminate the need for bin sweeps thereby reducing man hours and time required for removing the last ten to fifteen percent of seed from the bin. Elevated drive-under hopper bottom bins having smooth steel walls are the most expensive to install, but they also are the more flexible for use. They may be used for both bulk uncleaned seed storage and cleaned seed storage. Cleaned seeds may be bulk loaded into trucks or may be bagged directly from the bins with valve bag packers or sewing lines.

Whichever type bulk storage bins the seedsman chooses for his facility, the layout of those bins with regard to loading, unloading, flexibility and maintaining the seed quality is of utmost importance. All seams and cracks need to be filled with sealant and outside bin wall stiffeners should be used where possible instead of inside stiffeners. Also, if possible, the same variety of seed should be stored in the same identical bin as stored in during the previous year. Many seedsmen have found that the difference in soybean seed conditioning "clean-out" to be an average of four percent when the seeds were not stored in properly designed bulk storage facilities. Those loses are directly related to mechanical damage.

Placing bulk storage bins in rows in accordance with bin size then using distributing conveyors over the rows of bins is the choice of bin layout by most seedsmen. Drag conveyors having round-bottom troughs and hipped weather proof covers are your best choice for overhead distributing conveyors when multiple discharge gates must be used. Two-way leak proof bucket valves placed between the conveyor discharge gates and storage bins will help to eliminate the possibility of varietal mixing. The valves are placed in the "out" position at all times unless the bin directly below it is being filled.

E-Z down "bean ladders" attached to the bin sidewall can be used to eliminate splitting of fragile seeds such as low moisture soybeans. In situations where overhead conveyors are not used but instead seeds are spouted directly to storage bins, enclosed E-Z down ladders can be used in place of the more commonly used round spouts provided the seeds are of a dry flowable nature. Table 1 charts shows the velocity obtain by seeds in round spouts.

Both round bottom drag conveyors or belt conveyors are excellent choices of conveyors for reclaim and/or transfer conveyors from bulk storage to the seed cleaning equipment area.

Air-Screen Cleaning

Unless a debearding process is required in the conditioning plant, the first seed cleaning process is usually an air/screen cleaner. There are many different manufacturers of this type cleaner, but all use the same principles of air and screen cleaning. Optional features include metering hoppers with variable speed drive, top fan system, size and number of screens in the cleaner, screen flow

Table 1. Grain velocities in spouts.

Spout Length	Velocity in Feet Per Minute - Angle of Spout in Degree											
	35	40	45	50	55	60	65	70	75	80	85	90
5'	400	524	618	700	770	830	885	935	975	1010	1050	1075
10	570	742	875	990	1090	1180	1255	1320	1380	1435	1485	1520
15	696	908	1070	1210	1335	1440	1530	1615	1690	1755	1820	1860
20	805	1047	1235	1400	1540	1665	1770	1870	1950	2025	2100	2150
25	899	1170	1380	1560	1725	1860	1975	2085	2180	2265	2340	2400
30	985	1280	1510	1710	1890	2040	2165	2285	2390	2480	2570	2635
40	1135	1480	1750	1975	2180	2355	2500	2640	2760	2865	2970	3040
50	1270	1655	1950	2210	2440	2635	2800	2955	3090	3210	3320	3400
60	1390	1810	2140	2420	2670	2880	3065	3240	3390	3520	3640	3720
70	1500	1960	2310	2615	2880	3110	3315	3500	3660	3800	3930	4025
80	1605	2090	2470	2795	3080	3330	3540	3740	3905	4055	4200	4295
90	1705	2220	2620	2960	3275	3535	3760	3965	4250	4310	4460	4575
100	1795	2340	2765	3120	3450	3720	3960	4180	4370	4540	4700	4800
125	2005	2620	3090	3500	3860	4165	4440	4680	4890	5080	5250	5370
150	2200	2865	3390	3835	4225	4560	4850	5120	5350	5560	5750	5880
175	2375	3100	3665	4140	4565	4935	5250	5540	5790	6000	6215	6350
200	2540	3310	3900	4420	4880	5270	5600	5910	6180	6420	6640	6800

This table indicates approximate velocities that will be attained by whole dry grains flowing freely in smooth metal spouts of various lengths and of various angles in relation to the horizontal. The velocities are based on an angle of repose of 28 degrees for grain.

arrangements, variable shoe shake, adjustable pitch, screen rockers, variable bottom blast fan system, brush or ball screen cleaning, steel, wood or wood/steel construction.

Metering hoppers with variable speed drives provides an exact amount of feed to the cleaner. The cleaner hopper is a "feeding device" only and it is recommended that a surge bin of a size to accommodate at least two hours of continuous operation be placed above the cleaner.

The top fan system pulls air through the column of seeds as they are metered from the hopper to the top screen and removes large quantities of undesirable light product such as stems, sticks, weed seeds, pods, dust and hulls. The more off-grade product removed by the top air system, the less amount of cleaning is required for the screening operations of the cleaner. A properly adjusted top fan air separation would produce approximately three to five good seed kernels in a handful of off-grade from the top discharge spout. This check assures the seedsman that he is removing all off-grade types possible with the fan without undue loss of good seed.

If you are unable to remove a few good kernels with the top fan system, or the bottom fan system for that matter, check for back pressure in the air system from the fan outlet discharges through the air piping and to the cyclone or dust collecting system used. Some models of air/screen cleaners have sliding air gates which allow additional airflow directly into the eye of the fan to keep air velocities within the air piping at a sufficient speed to keep heavier dust particles from settling in the air piping system. Should dust particles be allowed to settle and build up in the air piping and dust removal system, increased back pressures from such a situation will not allow for a proper separation at the cleaner.

The size and number of screens in the air/screen cleaner will vary with the model the seedsman selects for his cleaning purposes. Most all precision cleaners have at least four screens which may be arranged in several flow configurations. It is always advisable for the seedsman to select an air/screen cleaner of sufficient size to obtain the desired capacity under the most difficult cleaning situations. Increased capacities are then realized when cleaning seeds having lesser amounts of contaminants to be removed from the seed mass.

Screen Nomenclature

Before discussing reasons for selecting specific shapes and sizes of screens for cleaning seed, let us review the numbering system used for numbering the different types of screens available. The size of a round hole screen is the diameter of the perforation. Perforations larger than the size 5-1/2/64th are measured in 64ths of one inch. Therefore, a 1-inch round hole screen is a No. 64;

a 1/2-inch screen is a No. 32, etc. Screens smaller than 5-1/2/64th are measured in fractions of one inch. The next smaller size being 1/12th.

Oblong screens are measured with the same system as round hole screens except that there are two dimensions that must be given. Large oblong or slotted screens have their width measured in 64ths of one inch; for example, the size 11/64x3/4. Slotted screens smaller than 5-1/2/64x3/4 generally have their width measured in fractions of one inch; for example, the size 1/12x1/2. There are some exceptions to this small-slotted-screen numbering system in that the sizes 5/64x3/4, 4-78x3/4, 3/64 x 5/16 and others are numbered with the large-screen numbering system measuring the width of the screen in 64ths of an inch. The final number is the length of the slot in fractions of an inch.

Wire mesh screens are numbered according to the number of openings per inch in each direction. A 10x10 screen has ten openings per inch across and ten openings per inch down the screen. The size 6x22 has 22 openings per inch across the screen and six openings per inch down the screen. Such openings as the 6x22 are rectangular in shape and are the wire mesh equivalents to oblong or slotted perforated screens.

Triangular screens may be measured in two ways. The system which is used most generally in the seed industry is to give the length of each side of the triangle in 64ths of one inch. The sides of the 11-Triangle are 11/64ths of one inch long. Another system used by perforators is to size the triangle as the diameter of the largest circle that can be inscribed inside the triangle. Figure 3 lists the screen sizes which are available to the seedsman for use in his cleaner.

Screen Selection

The two basic screens, top and bottom, for cleaning *round shaped seeds* are a round hole top screen and a slotted hole bottom screen. The round hole top screen drops the round seed through the closest-fitted hole that it can go through and lets anything that is larger or bigger be screened over and is referred to as "scalping". The seed pass onto a slotted bottom screen which takes advantage of the shape of the seed to hold up the round good seed and drop split, broken crop seed and many weed seed and is referred to as "sifting".

The basic top and bottom screen for cleaning *elongated seed* should be a slotted top scalping screen and a slotted bottom sifting screen. It may be necessary in some cases to pass seed through a round hole top screens or over some other shape than a slotted bottom screen to effect a special separation; but, when selecting the basic screens for elongated seed, slotted top and bottom screens are most generally used.

Another seed shape is the *lens-shaped seed.* The basic top and bottom screens for lens-shaped seeds are generally a slotted top screen and a round hole bottom

screen sizes

CLIPPER SCREEN SIZES

PERFORATED METAL SHEET

ROUND HOLES

Fractions	64ths	
.038	6	24
1/25	7	25
1/24	8	26
1/23	9	27
1/22	10	28
1/21	11	29
1/20	12	30
1/19	13	31
1/18	14	32
1/17	15	34
1/16	16	36
1/15	17	38
1/14	18	40
1/13	19	42
1/12	20	44
	21	48
	22	56
	23	72
		80

OBLONG HOLES

Fractions	64ths
	4⅜x¾
1/22x½	5x¾
3/64x5/16	5½x¾
1/20x½	6x¾
1/18x¼	6½x¾
1/18x½	7x¾
1/18x¾	8x¾
1/16x¼	9x¾
1/16x½	10x¾
1/15x½	11x¾
1/14x¼	12x¾
1/14x½	13x¾
1/13x½	14x¾
1/12x½	15x¾
	16x¾
1/22x½ Diag.	17x¾
	18x¾
	19x¾
	20x¾
	21x¾
	22x¾
	24x¾

TRIANGLES

64ths
8
9
10
11
12

OBLONG CROSS SLOT, ROUND HOLE HALF SIZES, OBLONG HALF SIZES

THESE SIZES STOCKED ONLY IN 26" x 53¼" SHEETS

OBLONG CROSS SLOT	ROUND HOLE HALF SIZES	OBLONG HALF SIZES
6x¾	5½	7½x¾
7x¾	6½	8½x¾
8x¾	7½	9½x¾
9x¾	7½	10½x¾
10x¾	8½	11½x¾
11x¾	9½	12½x¾
12x¾	10½	13½x¾
13x¾	11½	14½x¾
14x¾	12½	
15x¾	13½	
16x¾	14½	
18x¾	15½	
11½x¾	16½	
	17½	
	18½	
	19½	
	20½	
	21½	
	22½	

WIRE CLOTH

SQUARE OPENINGS

3x3, 5x5, 7x7, 8x8, 9x9, 10x10, 12x12, 14x14, 15x15, 16x16, 17x17, 18x18, 20x20, 22x22, 24x24, 26x26, 28x28, 30x30, 32x32, 34x34, 36x36, 38x38, 40x40, 45x45, 50x50, 60x60

OBLONG OPENINGS

2x7	4x8½	6x14	
2x8	4x15	6x15	
2x9	4x16	6x16	
2x10	4x18	6x18	
2x11	4x19	6x19	
2x12	4x20	6x20	
3x14 Sp.	4x 21	6x21	
3x16	4x22	6x22	
3x16 Sp.	4x24	6x23	
3x17 Sp.	4x26	6x24	
3x21	4x28	6x25	
	4x30	6x26	
	4x32	6x28	
	4x34	6x30	
	4x36	6x32	
		6x34	
		6x36	
		6x38	
		6x40	
		6x42	
		6x50	
		6x60	
		18x20	
		20x22	

In order to complete our service to you, Ferrell-Ross offers over 200 different size screens in the above listing.

A Few Typical Styles and Screen Perforation Sizes. See Above List for Larger, Smaller, and Intermediate Sizes.

(Notice: Openings illustrated are not scaled to exact size)

"Clipper" perforated and wire cloth screens are the *best* seed cleaning screens you can buy. Tolerance differences are kept to minimum and the design of each opening is exactly right to make a precision separation.

"Clipper" wire cloth screens are electroplated after weaving with a non-corrosive metal to give the best possible rust protection as well as strong resistance against normal wear.

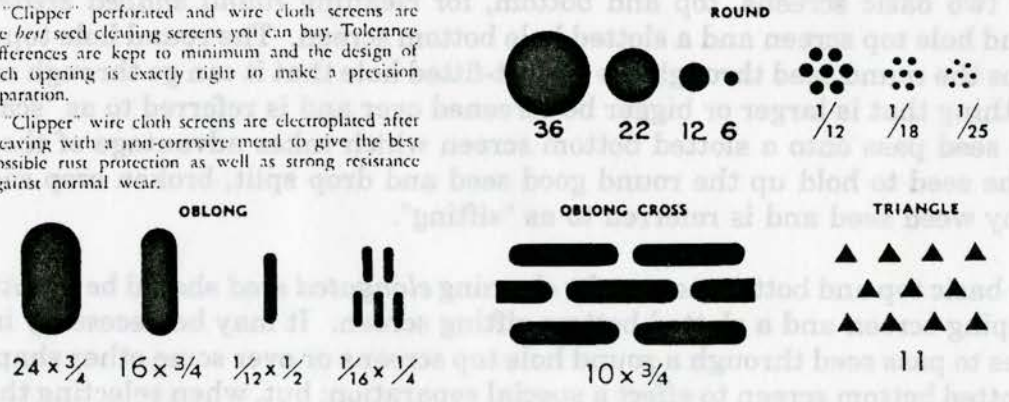


Figure 3. Sizes and types of screen perforations available for air-screen seed cleaners.

screen. These shapes allow the best cleaning possible with a minimum of one top and one bottom screen. The lens-shaped seed will turn on edge and drop through a slotted top screen and lie flat and pass over a very large, roun-hole bottom screen that will drop from them most weed seed and other crop seed.

Since most commercial processors of seed use cleaners having more than two screens, the general rule most frequently followed for selecting top and bottom screens is to equip the cleaner with round hole and oblong top scalping screens, one each in each shoe, and oblong and round, square or triangular bottom sifting screens, one each in each shoe. With few exceptions this assures the most thorough and complete screening.

Hand testing screens allow the seedsman the advantage of selecting the proper screen openings and shapes for each cleaning problem prior to loading the screens into his cleaner. Twelve-inch square hand testing screens are much easier to handle for test purposes than say a screen which is 54" x 60". Since the actual physical size of some varieties of the same seed types differ, it is usually always necessary to have a selection of different sized scalping and sifting screen sizes from which to choose.

Gone are the days when a seedsman having a four-screen cleaner would have two top scraping screens and two bottom sifting screens marked "BEANS" for the cleaning of soybeans. If large soybeans numbering 2100 to 2500 per pound are to be cleaned, then top scalping screens in round hole sizes 20/64, 21/64 or 22/64 and bottom sifting screens in slotted hole sizes 11/64x3/4, 12/64x3/4 or 13/64x3/4 would be used. However, if very small soybeans numbering 3700 to 4200 per pound are to be cleaned then top scalping screens in round hole sizes 74/64, 18/64 or 19/64 and bottom sifting screens in slotted hole sizes 8/64x3/4, 9/64x3/4 or 10/64x3/4 would be used. Some morning glory seeds are too plump to fall through the smaller sizes of slotted screens. If you encounter this problem, you will have to use a smaller round hole bottom screen such as a 12/64 or 13/64 which will allow the morning glory seeds to drop through but pass the soybeans over.

You can see from this example that if you plan to process different varieties of soybeans having different sizes as shown above, you would need to have on hand all round hole screen sizes from 17/64 through 22/64 plus 12/64 and 13/64 as well as all slotted screens from 8/64x3/4 through 13/64x3/4. You should have a complete set of hand testing screens with these same identical sizes.

Methods to Increase Efficiency

Some seedsmen having cleaners with only one bottom sifting screen or two bottom sifting screens with a special separating problem may want to consider what are referred to as "combination" screens. That is, they have two or more sections of different screen perforations on one screen frame. If restricted to one bottom

sifting screen for cleaning a medium sized soybean contaminated with morning glory, the seedsman could use one section of 10/64x3/4 slotted hole screen material on one frame as his sifting screen which would allow both morning glory seeds and soybean splits to pass through in one cleaning operation.

Screen dams are objects fastened to a screen to make it sift more accurately than normal. They are used when very close and accurate separations of small round seed must be made or on cleaners having non-adjustable pitch screens. Dams may be made of any sort of material but are commonly strips of wood lath about 1/4-inch high and 2-inches wide. When fastened over the cross braces of the screen with nails or screws, they interrupt the smooth flow of the seed down the screen, cause them to stop momentarily and be thoroughly sifted which gives the seed that should be dropped through the screen plenty of opportunity to contact the perforations. Dams are generally used only on bottom sifting screens and when used on round hole bottom screens, the accuracy of sifting is so increased that a heavier layer of seed may be placed on the screen with a resultant increase of capacity.

Another device that can be used to improve the separation that a top scalping screen makes is a piece of oil cloth or canvas apron with the slick side down and lying flat on the screen. The weight of the apron tends to hold long pieces of straw and stems flat on the screen so that they do not turn on end and go through with the good seed but are separated.

It is often a good practice to blank off the lower portion of a top scalping screen. Once the point at which all of the good seed drop through has been determined, all of the top screen from that point downward to its end can be blanked off with paper, tape or blank screen material so that any foreign materials passing over the top portion of the screen perforations will pass onto the blanked-off section and have not further chance to turn on end and go through with the good product.

Adjustments

Variable shoe shake means that the speed of the eccentric shaft can be changed in order to provide the proper speed to clean any given seed type and is recommended if several different types of seeds are to be cleaned. Each type of seed requires a certain amount of agitation to properly separate the seed kernels and seed texture will dictate its flow ability characteristics. For example, fuzzy cottonseed will require a higher eccentric shaft speed than will soybeans.

As the sifting screen portion of the screening process almost always determines the capacity of the cleaning process, it is important to impart the proper agitation to the seed mass which will allow the smaller particles to drop to the sifting screen, find a perforation and drop through to the bottom pan. It is also very important to be sure the eccentric shaft speed is sufficient for proper ball action

in cleaners having ball tray screen cleaning systems. Too slow a speed and the screen perforations will "blind over" prohibiting the desired sifting separation.

Adjustable pitch screen rockers vary the degree of steepness of the screens. A steep pitch will walk the product over the screen faster with less exposure to the screen surface and is generally the setting for the top or scalping screen. A flat pitch will allow more seed exposure to the screen surface and is the setting for the bottom sifting screens (Figure 4). Variable eccentric shaft speed and adjustable pitch screens work simultaneously to provide the seedsman with the complete range of settings to properly clean any seed type be it the very smallest of seeds such as clovers to the largest of beans.

Ball tray screen cleaning systems have in most cases proven to be the best all around system for all seeds and screen types. Use the number of balls recommended by the manufacturer of your cleaner as ball tray configurations differ with different manufacturers. However, if your cleaner screens seem to be imparting a more violent action to the seed mass than you feel is required, you may want to try using one or two less balls per tray compartment than is recommended. Balls used by one manufacturer's cleaner will not necessarily interchange with another manufacturer's cleaner. Be sure of the size and bounce characteristics of replacement balls.

Variable speed bottom blast fan systems provide one final air separation prior to the seeds being discharged from the cleaner. This fan system will remove any dust or hulls that may have become detached during the screening process and in some cleaning processes will remove lighter undesirable seeds having the same basic physical size but a lesser specific gravity. An example would be "slick" cockleburs from soybeans.

After the basic cleaning by the air/screen cleaner, final finishing separations may be obtained from any number of different types of finishing machines. Included in these types for the seedsman's use are spirals, indented cylinders, gravity separators, precision sizers, disc mills, aspirators, dodder mills, magnetic separators and color sorters.

Summary

In closing let me recommend that if you are unsure of the types of cleaning equipment that you should be using in your seed cleaning operation or if you are not sure of the arrangement of these types of equipment, inquire with the manufacturers for their recommendations or consult with a design engineer not only familiar with different types of seed conditioning equipment, but also familiar with the types of seeds and contaminants in your area. After all, the product you put in the bag is a direct reflection upon you as a seedsman.

Figure 4. Adjustment of screen pitch.