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The Seed Plant: modern Concepts

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THE SEED PLANT: MODERN CONCEPTS

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The modern seed plant should function smoothly and have the ability for all plant operations to operate simultaneously as a team with the goal being to produce a high quality seed product while keeping product loss and required man hours at a minimum. Although automation and computer control are taking over at unbelievable speeds, farming, seed production, seed conditioning and seed sales are governed by, and proportional to, human attributes and ability. Therefore, the use of scientific tools insofar as seed conditioning is concerned, depends largely upon human judgement.

My primary field of endeavor is with seed processing in whatever condition it comes to you, the seedsman. What the grower does with seed from planting to harvest, with the aid of science, industry and mother nature and until it reaches your conditioning facility tells us what we must attempt to provide in the way of mechanical equipment to enable you to have pure seed to sell. The following concepts need to be considered by the seedsman if planning a new facility or if he has an existing plant which could be updated somewhat using those ideas for changes which would not be too costly.

Receiving Area and Equipment

The first operation at any plant is the receiving of seeds from the grower and a first concern is sampling. The use of a vacuum probe to retrieve samples from the grower's truck makes this task quick and simple. The samples are retrieved by the probe, conveyed through a suction line and deposited into a collection box inside the office lab area. The vacuum probe is capable of reaching into even the furthest corners of the truck bed thereby eliminating the need for a worker to physically climb onto the truck which is timely and somewhat hazardous.

Large receiving pits having a top open area of approximately ten feet wide and twelve feet long capture most of the bulk seeds if either a hydraulic truck dumper or hopper bottom trailer is used. Seed splash outside the pit open area will require timely clean-up when changing varieties. The pit grill needs to be

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manufactured in such a manner as to eliminate flat open surfaces on the "I"-beam supports and all cracks and crevices should be filled. A vibrating shaker spout under the receiving pit will convey all seeds into the receiving elevator boot gently and is recommended when conditions will not permit the installation of a complete gravity-flow pit.

The use of two identical bucket elevators in the receiving pit offers many advantages. Some of these advantages include:

1. By spouting both elevators to all points, one elevator can be used to receive should the other have a break down.

2 Seeds of different varieties can be received on alternating loads without delays in boot clean-out.

3. Seeds of one variety can be received while simultaneously reclaiming seeds of another variety, or type, from bulk storage and transferring these seeds to the processing plant for conditioning.

Bucket elevators are manufactured by numerous companies, but only those designed specifically for gently handling should be considered for seed plant use. With the correct head shaft speed, a bucket elevator cup will discharge the seeds directly into the throat of the elevator. In high speed elevators the seeds are actually thrown against the inside of the elevator head and down-legging of seeds occurs thereby imparting mechanical and germination damage. Figure 1 illustrates that 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 with little or no back-legging or down-legging. A slight deviation such as five (5) revolutions per minute (RPM) above or below optimum speed causes the cups to spill or throw seeds.

Plastic elevator cups are used to prevent damage on impact between seed and cup. Cup bolts should be used with both flat and lock washers with the flat washer against the inside of the plastic cup. This method of installation prevents the bolt from pulling through the cup. Nylon spacer washers (Figure 2) between elevator cup and belt help to prevent lodging of seeds causing varietal mixing.

Just as care should be given in the selection of the type of bucket elevator to be used in a seed conditioning plant, the selection of distributor is just as important. Distributors with interlocking turnspouts and hopper bottoms with overflow spouts are most recommended (Figure 3). Distributors with a flat bottom and a sliding internal spout are a main source of varietal mixing. When the internal spout is not in direct alignment with the outlet spout, spilling takes place within the body of the distributor. When the internal spout is then moved to an alternate opening, the seed spillage within the distributor body is pushed by the internal

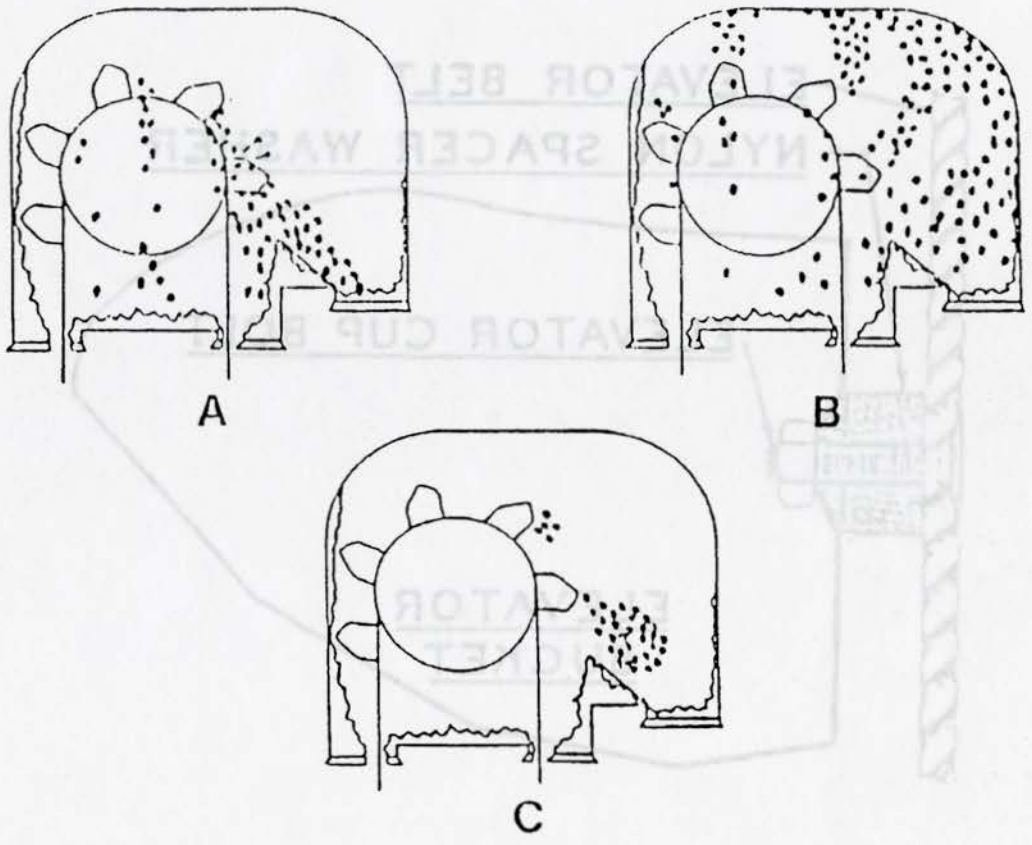

Figure 1. Centrifugal discharge bucket elevator. (A. Head pulley speed too slow; B. Head pulley speed too fast; C. Optimum head pukley speed.)

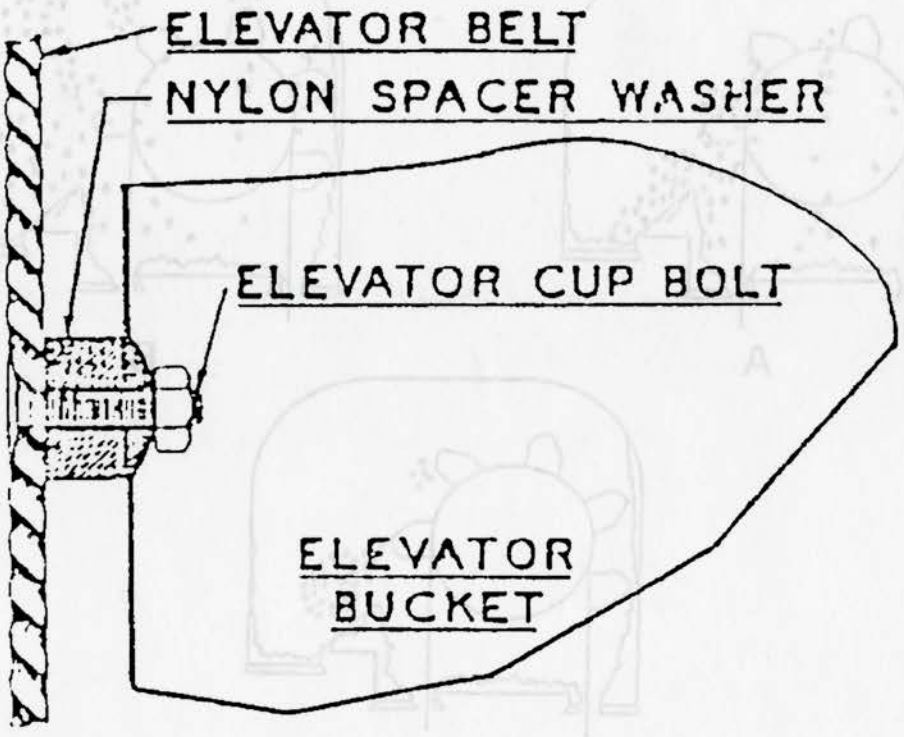

Figure 2. Spacer washer placed between belt and bucket to prevent mixtures. Recommend washer size: 1 in. dia. and 05 in. thick.

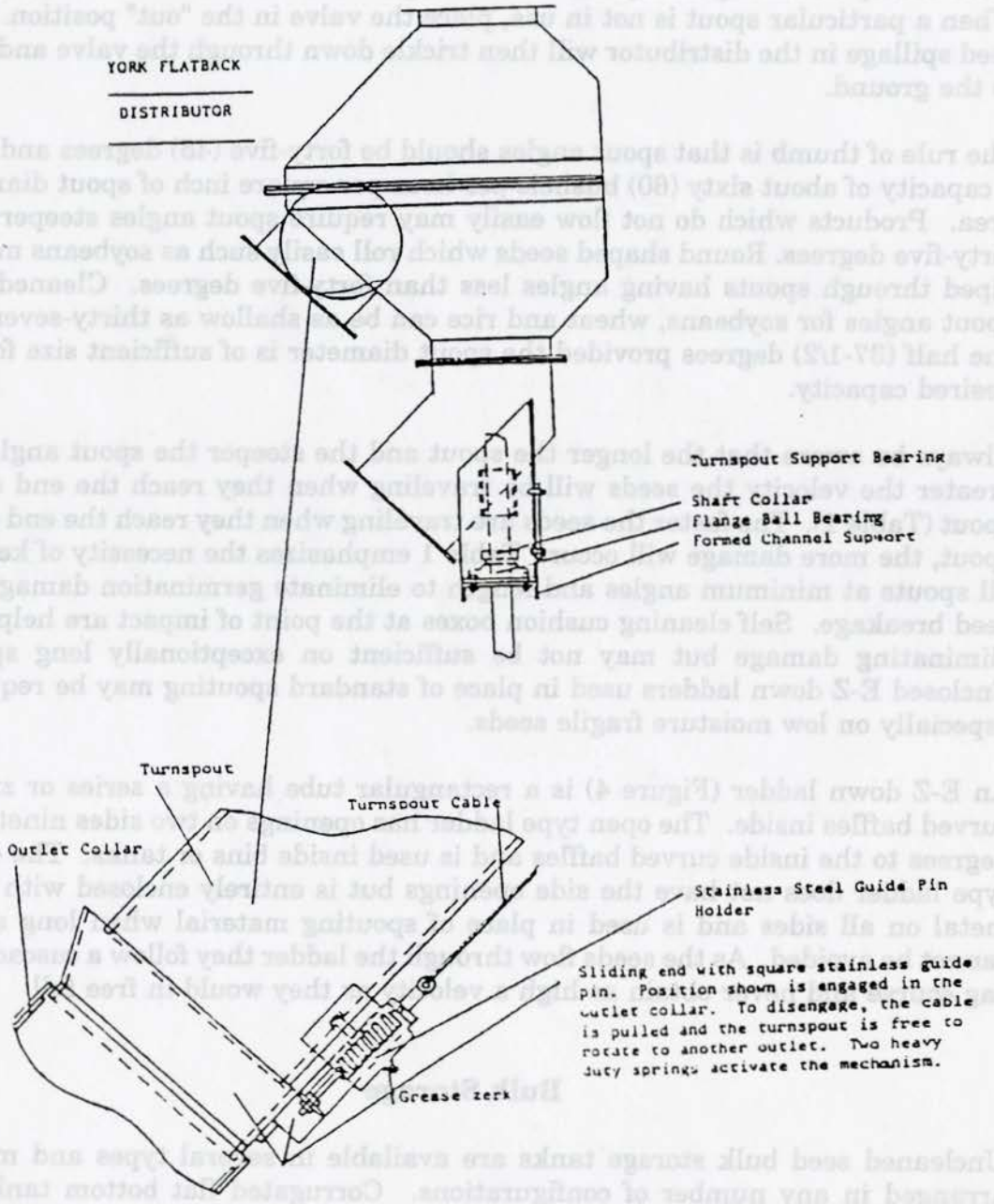

Figure 3. Hoppered bottom distributor with interlocking turnspouts.

spout to an adjacent outlet where seeds continue down that spout and into another bin or conveyor and varietal mixing occurs.

If you have an existing distributor that is suspect to mixing problems, it may be corrected by installing leak proof lock out type bucket valves in existing spouts. When a particular spout is not in use, place the valve in the "out" position. Any seed spillage in the distributor will then trickle down through the valve and drop to the ground.

The rule of thumb is that spout angles should be forty-five (45) degrees and have a capacity of about sixty (60) bushels per hour per square inch of spout diameter area. Products which do not flow easily may require spout angles steeper than forty-five degrees. Round shaped seeds which roll easily such as soybeans may be piped through spouts having angles less than forty-five degrees. Cleaned seed spout angles for soybeans, wheat and rice can be as shallow as thirty-seven and one half (37-1/2) degrees provided the spout diameter is of sufficient size for the desired capacity.

Always be aware that the longer the spout and the steeper the spout angle, the greater the velocity the seeds will be traveling when they reach the end of the spout (Table 1). The faster the seeds are traveling when they reach the end of the spout, the more damage will occur. Table 1 emphasizes the necessity of keeping all spouts at minimum angles and length to eliminate germination damage and seed breakage. Self cleaning cushion boxes at the point of impact are helpful in eliminating damage but may not be sufficient on exceptionally long spouts. Enclosed E-Z down ladders used in place of standard spouting may be required, especially on low moisture fragile seeds.

An E-Z down ladder (Figure 4) is a rectangular tube having a series or zig-zag curved baffles inside. The open type ladder has openings on two sides ninety (90) degrees to the inside curved baffles and is used inside bins or tanks. The closed type ladder does not have the side openings but is entirely enclosed with sheet metal on all sides and is used in place of spouting material when long spouts cannot be avoided. As the seeds flow through the ladder they follow a cascade zig-zag course and never obtain as high a velocity as they would in free fall.

Bulk Storage

Uncleaned seed bulk storage tanks are available in several types and may be arranged in any number of configurations. Corrugated flat bottom tanks are better designed for drying with stir-all systems and have the advantage of being lower in cost per bushel of storage than most other types of tanks. Corrugated hopper bottom tanks offer the advantage of being practically self cleaning but are higher in cost per bushels of storage than flat-bottom tanks. Although hopper-bottom tanks can be provided with aeration systems, drying is not recommended

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.

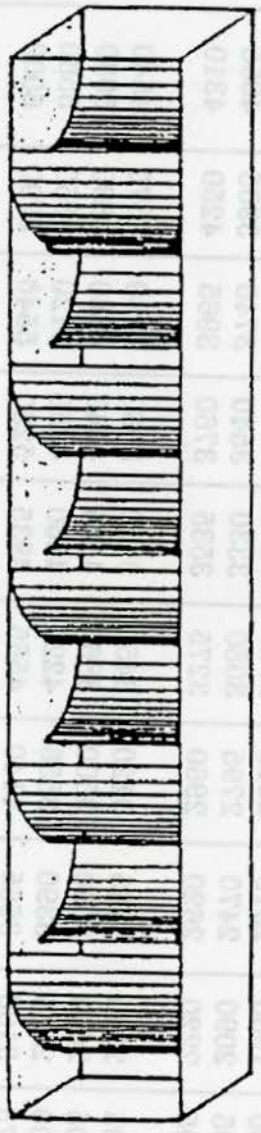

Figure 4. Bean ladder used to minimize mechanical damage in free drops.

because of the concentrated heat source. Specially constructed welded steel tanks have the highest cost per bushels of storage but they have smooth inner sidewalls and have the advantage of being used for both bulk uncleaned seeds and then for cleaned seeds. Like hoper-bottom tanks, welded steel tanks may have aerations systems but drying is not recommended.

If the budget permits, sufficient bulk field seed storage, properly designed for all of your more fragile seeds, is highly desirable. Many seed conditioners report an increase average clean-out (loss) of four percent when their contracted soybeans are stored in on-farm bins. Due to the increased costs, most on-farm storage is not properly designed for fragile seeds.

The three best types of conveyors to use for the handling of seeds are drag-flite conveyors, belt conveyors and vibrating conveyors. These types of conveyors are of the self cleaning type and handle seeds gently with the least amount of mechanical damage. Drag-flite conveyors are recommended for use as the distributing conveyor over bulk storage tanks when the tanks are arranged in an in-line configuration and multiple discharge outlets are required. A leak proof bucket valve installed between the conveyor discharge gate and the tank dome cap (Figure 5) will eliminate any chance for varietal seed mixtures.

Belt conveyors are best used where seeds are to be conveyed for long distances without having any intermediate discharges. However, drag-flite conveyors are also a good choice for this type application.

Vibrating conveyors are best used where distances are short. In the past, vibrating conveyor frames had to be bolted to the floor or other sturdy structure because the vibrating action of the pan was not counter-balanced. This is still the case with some manufacturers' conveyors. However, there are now manufacturers of counter-balanced vibrating conveyors having intermediate discharges that can even be suspended from cables. Vibrating conveyors are also available with intermediate perforated pans which offer the seedsman the ability of scalp, sift and scalp/sift applications within the conveyor.

Precleaning

The cost of installation and clean up problems when more than one variety of seed is being received simultaneously are the main objections to precleaning seeds as they are received. Since precleaning, however, removes most of the large and small foreign materials in the seed mass, more desirable seeds can be stored in the bulk tanks. Aeration and drying costs are also minimized with removal of undesirables. With most of the foreign matter removed from the seeds during precleaning, capacity during the actual precision cleaning process is increased.

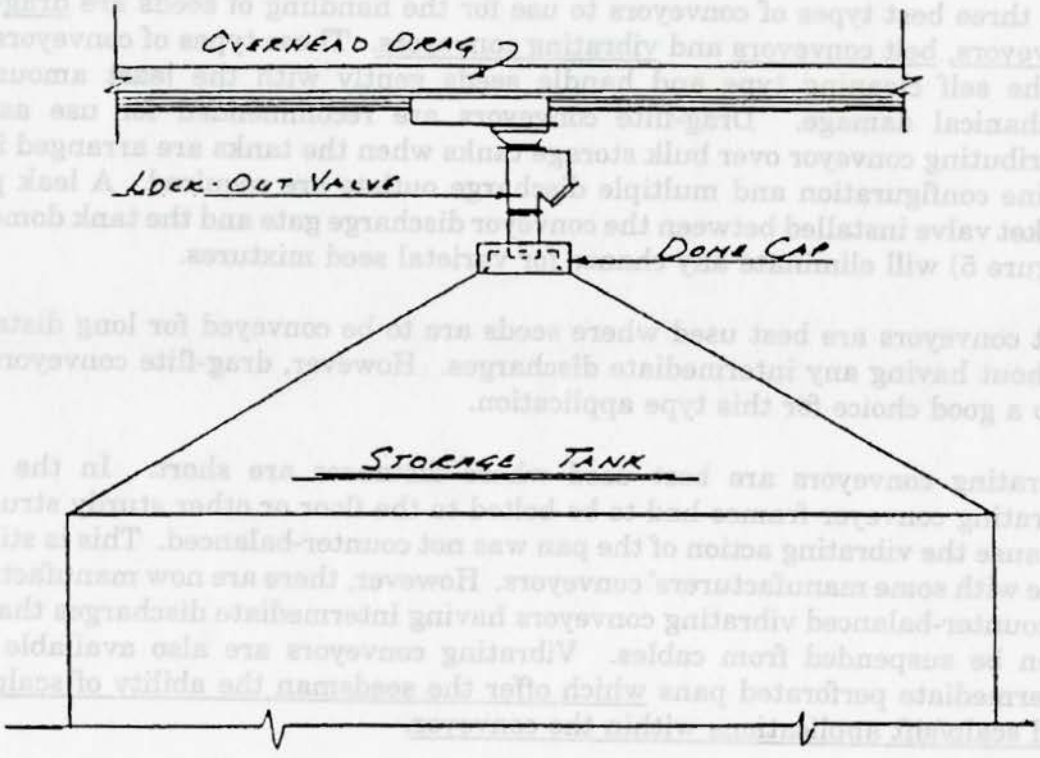

Figure 5. Lock-out valve located between intermediate discharge of drag flight conveyor and storage bin.

Precleaners are mostly installed when a seedsman has at least 100,000 bushels of one variety of seed to receive. He uses two receiving bucket elevators in the receiving pit: one feeding the surge bin over his precleaner, and the other feeding directly to bulk storage. When a truck dumps the variety of which he has the greater amount, he uses the bucket elevator feeding the surge bin over the precleaner. When another variety is received, the second bucket elevator is used to divert the seed to bulk storage by-passing the precleaner. After harvest, the seedsman can then bring the varieties in lesser amounts back through the precleaning process and transfer them on to the cleaning plant or back to bulk seed storage tanks.

Precision Cleaning Operations and Layout

Several models of air/screen cleaners of both wood and steel construction are available for the seedsman's precision cleaning operation. Air/screen cleaners having both top suction fan and bottom blast fan air separations are desirable for commercial seed conditioning plants. Other features which should be considered when selecting the air/screen cleaner are:

- Adjustable feed hopper.
- Variable air controls.
- Adjustable screen pitch.
- Variable shoe shake
- Screen cleaning balls or brushes.
- Accessibility of parts.
- Number and size of cleaning screens in cleaner.
- Screen flow options.

Always select the air/screen cleaner of proper size for desired capacity considering the worst possible percentage of contaminants which are to be removed. In borderline cases it is best to select the next larger size air/screen cleaner. This basic rule is also good to follow in selection of all other types of finishing equipment such as spiral separator, gravity separator, length and thickness graders, packaging equipment, etc.

As the air/screen cleaner is the first piece of conditioning equipment inside the cleaning plant into which the seeds are introduced, the over-cleaner bin should have sufficient holding capacity to operate the cleaner continuously for at least

two hours. Reclaim conveyors and bucket elevators from bulk storage require a minimum amount of personnel attention in order to keep the seed cleaning equipment operating at full capacity when a large over-cleaner bin is used.

Surge bins over finishing equipment need not be of the same capacity, but should be of sufficient size to allow flexibility in properly adjusting each piece of equipment. It is recommended, however, that the holding bin above the sacking equipment be of equal or larger capacity than the over-cleaner bin to allow plant personnel time to see to any emergency situation without having concern for shutting down the cleaning plant. Bin discharge gates need to properly match the inlets of each piece of cleaning equipment for which they are designed. Capacity and cleaning efficiency are drastically reduced when this rule is not followed.

Wide access walkways around cleaning equipment are very desirable because they allow work space for maintenance. Two-foot wide walkaways should be the minimum but three-foot wide walkways are best. Handrails, kneerails and toerails need to follow OSHA standards and stairways in place of access ladders should be used where possible.

The cost of today's construction materials cause high overall costs in trying to build a high-rise, total gravity flow plant. For this reason newer plants are designed and built using multiple bucket elevators. The number of bucket elevators required can be kept at a minimum in handling fragile seed commodities if some gravity flow is designed into the plant. For example, if you are using both spiral separators and a gravity separator for cleaning soybeans, locate the spiral separators above the gravity separator. Wheat and rice seeds are not as susceptible to breakage as are soybeans but all seeds need to be handled gently. Gravity flow, where possible and economically feasible, is recommended. Again, when bucket elevators are used inside the cleaning plant, select those having optional head speeds and easy dump discharge features. Slatted boot pulleys help to eliminate the mashing of seeds between the boot pulley and elevator belt.

Enclosed spiral separators have been replacing the original open type spirals. Enclosed spiral separators offer the advantages of keeping dust contained within the spiral cabinet, greatly reduced noise level and the spiral cores may be interchanged with those of different flite configurations for special required separations such as edible soybeans.

Seed Treatment

If seeds are to be treated, isolate the treater in a separate room from the rest of the cleaning plant. A costly problem can be eliminated by being sure red-dyed seeds do not mix with splits and off-grades that are being sold to grain elevators. Manufacturers of treaters will be glad to advise you as to which of their coating chambers are specifically designed for fragile seeds. Often the coating chamber

furnished as standard equipment with treaters will perform well on seeds such as wheat and rice but because of their design will cause some mechanical damage on soybeans.

Packaging Systems

Valve bag packers are real time and space savers. A valve packer having a ten (10) horsepower blower can bag six to seven sixty (60) pound bags of seed per minute and since the bags are self sealing without "ears" they can be palletized in a minimum amount of space. It only takes one person to operate a twin-tube packer at twice the bagging capacity of one unit which would then be twelve to fourteen bags per minute. New electronic weighing systems on valve packers are said to have an accuracy of plus or minus 1/10 pound and are not effected by heat or cold weather changes. Bag weights on electronic packers can be checked while the bag is on the fill spout which is also a time saver. Automatic palletizers, although quite expensive to purchase, offer savings in time and labor costs.

Summary

Seedsmen always seem to be striving for ways to produce cleaner and more healthy seeds with high vigor and germination for their customers. Because the seed industry has become such a highly competitive business, the time comes when a seedsman must consider updating his conditioning plant. When the decision is made to update his plant the seedsman will want to consider several options. Updating considerations may include:

- Replacing screen cleaning brushes in air/screen cleaners with ball tray screen cleaning systems. Check with the manufacturer of your unit for pricing and availability.
- Replacing old style open spiral separators with enclosed units.
- Addition of gravity separators, length graders and/or precision graders for a more precise separation of seeds and contaminants.
- Converting valve bag packers having a mechanical weight control to a more precise electronic type control system at a cost which is generally recovered within a year in savings of bagged seed losses.

If you are a seedsman planning to construct a new seed conditioning facility or want to update an existing plant, contact someone with experience in plant design. His concepts and services will help to provide you with a modern seed producing business.