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TRIANGULAR DECK GRAVITIES VS RECTANGULAR DECK GRAVITIES
VS STONERS - WHICH SHOULD THE SEEDSMAN USE ?

Oliver W. Steele 1/

Not too many years ago the seedsman had a choice of only two or three models of Gravity Separators made by several manufacturers. All of these models were similar in shape, and similar in capacity and efficiency. There was little choice on the part of the seedsman as to which make of Gravity to buy. The capacity of these Gravities was in proportion to the deck area; the larger the deck area, the greater the capacity. The practice among manufacturers was to produce a small, a middle size, and a large machine. These three models were about all any manufacturer had to offer. Several decks of different covers were offered, and if a seedsman had about three decks, he was able to clean all seed stocks ranging in size and weight from the grass seeds up to the size and weight of beans, seed corn, and similar stocks. A processor who specialized only in the cleaning of beans was offered a Gravity which could almost instantly be changed to a machine for cleaning grass seed and other light seeds. Likewise a seedsman who specialized in the cleaning of alfalfa was offered a machine having a built-in blower and powered with a motor large enough to clean beans. Many Gravities are still being used which are powered with 15 and 20 h.p. motors and these machines are of rather limited capacity and efficiency as compared with present day Gravities. I always have to smile when I see a seedsman driving a later model car and know that his cleaning plant has machinery dating back 30 or 40 years. But we still have seedsmen doing the job the way their grandpappy did it. I question though whether their bank balance is as sound as their grandpappy's. Grandpappy had the latest in processing machinery at the time of his purchase.

The trend today in seed processing machinery is toward machines of higher efficiency and higher capacity. We have reached the age of "Specialized" machinery which is fast replacing the "universal" machines of yesterday. This trend is being hastened by wide-awake seedsmen who are demanding faster and better machines. Increases in labor costs, high taxes,

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(and a hundred and one other fixed costs) have put an additional squeeze on already narrowing profits. Of course the answer to the narrowing profit problem is, larger volume, quicker turnover, and extended trade territory. In order to attain this objective, the seedsman must have the machinery to quickly clean his seed stocks between the harvest and the spring planting.

The seedsman today must convert into cash the last trace of saleable seed flowing through his cleaning plant. He must therefore make a study of all types of seed processing machinery. He must know which type of machine will do his job more efficiently on a given seed mixture. He must know the limitations of each machine. He must know his costs to a fraction of a penny. He must be willing to retire his old "pets" and he must invest in new and better equipment in order to keep on the right side of his ledger. In short, he must pattern after the meat packer who utilizes the last squeal of the pig.

I mentioned a moment ago of the trend toward specialized machines, that is, machines designed to do a specific job. As an example, I mentioned that the bean processor is not particularly interested in a Gravity which can be instantly changed to a Gravity for alfalfa. Likewise the processor of small seeds is not interested in a Gravity capable of being converted into a bean machine on short notice. Therefore the "universal" Gravity is becoming a machine of the past, but there will always be a few made until a better process is discovered. For that matter, horse collars and curling irons are still being made.

Not too many years ago from five to eight Gravities were needed to keep abreast of one Cleaner. Today we have many installations with one Cleaner followed by one Gravity. And we do not as yet see the stopping point. As new and better Cleaners are developed, Gravity manufacturers must do likewise. I might insert the thought here that we have always recommended that a Cleaner be used ahead of the Gravity. A Gravity performs at its highest efficiency when processing seeds which have previously been closely sized.

The sale of a specialized Gravity is sometimes a little difficult to put across. Should we question the prospective customer too closely as to the intended use of the machine, he generally becomes suspicious that we are trying to learn too much about his business, or his trade secrets, if any. In the case of the alfalfa processor, we have developed a Gravity having a capacity of 2000-2500 lbs/hr and only requires a 1 h.p. motor. Compare this machine with the Gravity of yesterday having a capacity of 500-600 lbs/hr and uses a 5-7 1/2 h.p. motor.

Pioneering a new idea is expensive and we do not make too much of an effort to talk our customer into a specialized machine. If he wants the old

orthodox Gravity with the large motor, and if he wishes to continue paying a high connected load rate, and if he wishes to process his alfalfa with the air controls barely cracked, we give him exactly the machine he wants even though he could have a better machine at less initial cost. This leads me up to my subject, "Gravity Separators", and "which type of Gravity Separator is best for a given job?"

Gravity Separators may be divided into three general types: (1) Triangular Deck Gravities, (2) Rectangular Deck Gravities, and (3) Stoners. There are also variations of these three types. There are installations using one type in conjunction with another type, for example, Stoners recleaning the sand and rock product from Gravities. We make all three types and for nearly 25 years we made only the Triangular Deck type.

Some six or seven years ago we made a rather extensive survey of the use of Gravities. We found that over 80% of Gravity work consisted of the separation of a small fraction of light seed from a large fraction of heavier seed. We then began the development of a special machine to reduce the volume of the middling product and the more efficient separation of the lighter product to reclean. We knew the answer to our problem before hand, which was a deck having extremely long travel of the higher seed. These experiments led to the development of the Rectangular Deck, and also to the development of the multiple fan system which reduced the power consumption over 60%. Patents were granted in August of 1956 on the multiple fan system.

Figure 1 illustrates the several areas formed on the Triangular Deck Gravity.

The most important area is the Stratifying Area. Without thorough stratification of the particles composing the mixture, there can be no efficient separation. This stratifying area depends on the difference in the specific gravities existing between the particles, and the rate of feed. Excessive feeding will cause a corresponding increased area, in fact, it is possible to overfeed a Gravity Deck to the extent that the entire deck area is covered by the stratifying zone. In this case, no separations can be expected.

On the other hand the failure of many a Gravity is caused by under feeding. There must be a thickness of particles in order to stratify. A thin depth of seed cannot be formed into zones of differing weights. There must be a depth of sufficient thickness that the lighter seeds will be lifted to the top by the air jets coming through the deck cover while the heavier seeds will form a zone on the deck surface.

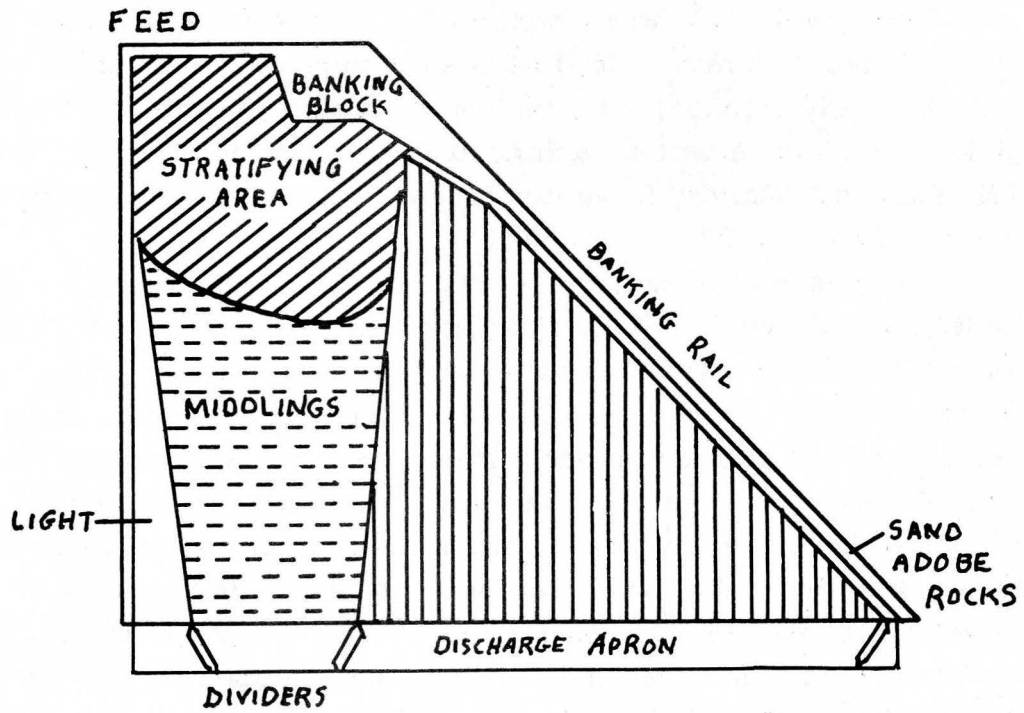


Figure 1

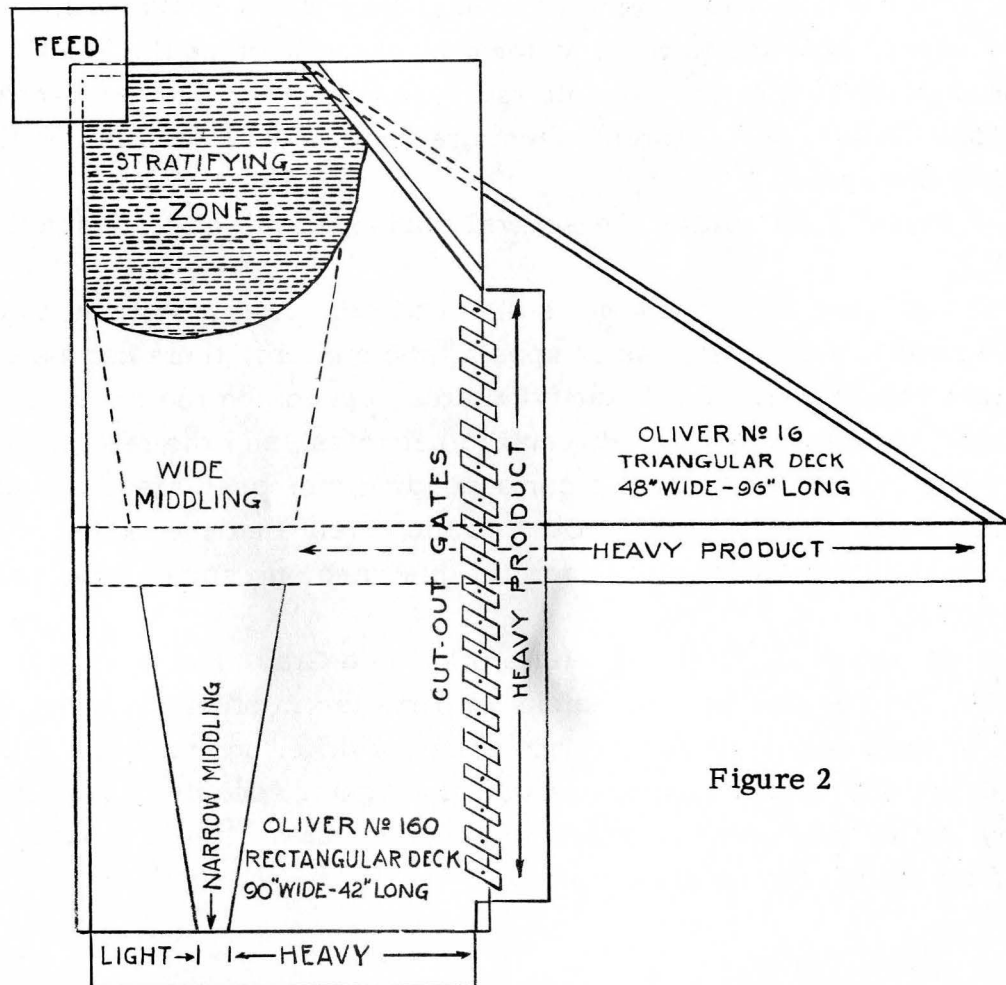


Figure 2

It may be seen by the above brief discussion that the rate of feed is most important. Again, the rate of feed depends upon the difference in specific gravities existing between the particles in the mixture. A mixture composed of particles differing greatly in specific gravity, may be fed faster than a mixture composed of particles differing only slightly in specific gravity.

The above remarks will apply to any Gravity Separator Deck regardless of shape or size. Once this line of thought is understood, the operator should experience no difficulty in getting the highest efficiency from his machine.

Figure 2 represents the Oliver No. 16 Triangular Deck Gravity 48" x 96" and the Oliver No. 160 Hi-Cap 42" x 90" Rectangular Deck. Both Decks have approximately the same area.

Each of these Decks have been given the same amount of feed which will form equal stratifying areas.

Notice that the Middling Product becomes progressively smaller in volume as it travels the full 90" length of the Rectangular Deck. The net result is that more tailings are made; likewise more of the heavier seed product; with corresponding less Middling product. On an average seed separation approximately 2/3 less Middling Product is made on the Rectangular Deck which is roughly the same results as re-running the Middling Product over the Triangular Deck three times.

The Triangular Deck is a good Deck for separating a small fraction of heavy particles from a large fraction of lighter. This is because of the long travel of the heavier particles. Triangular Decks are especially efficient for cleaning grass seeds containing a small fraction of heavier weed seeds, sand, etc. A small amount of chaff is removed from the tailing side.

The Middling Product

No general discussion of Gravity Separators can be complete without a few remarks on the "Middling Product". This has always been a problem in the past and will likely remain with us so long as Gravities are used. It is yet to be completely solved and a full discussion of the problem will require much more time than is allowed on this program, but I might pass the following brief remarks.

The Middling Product is a partially separated mixture lying between the heavier and lighter zones reporting at the discharge apron of the Gravity Deck. It is usually a mixture containing too many good seeds to be discarded as waste and too many saleable seeds permit being classified as a finished product.

There is always a Middling Product between the number of grades being cut from a Gravity. If two grades are being made, a light and a heavy, a

Middling Product will occur between. If three grades are being made, there will be two Middling Products, and so on.

Various methods are being employed to reduce the Middling Product. The following methods are the ones most commonly being used:

1. Returning the Middling Product to the feed of the Gravity through a small elevator.
2. Accumulating the Middling Product to be re-run over the Gravity at a later period.
3. Returning the Middling Product to the head of the cleaning system.
4. The Middling Product from several primary Gravities is fed to a secondary Gravity which has been carefully adjusted to separate particles of very slight difference in specific gravity. This method is used in extremely large operations.
5. Using Gravities in series. The Middling Product from a large Gravity is sent to a small size Gravity and the Middling Product in turn is sent to a still smaller size Gravity.

There are other methods in minor use. Of the five general methods listed above, we recommend No. 3. Here the Middling Product is passed over the cleaner again and becomes thoroughly mixed with the original commodity being cleaned. It becomes a more homogeneous mixture for the Gravity. A uniform mixture is the ideal feed to a Gravity. Uneven mixtures to a Gravity will cause "surging", or irregular flow on the Deck and necessitates frequent changing of the dividing fingers. Careless operation of the Cleaner will cause an increase of the Middling Product.

The Middling Product should be frequently examined. In many cases a close examination will reveal large reject seed reporting with smaller saleable seed. Merely passing such a mixture over a small screen having the proper openings will help solve this problem.

Common Installation Mistakes

1. Gravity Installed on a Weak Foundation
2. Blowers Running Backwards
3. Protector Over Air-Filter Not Removed
4. Air Not Clean
5. Machine Running With Loose Clamps
6. Using Wrong Deck
7. Trying to Obtain Capacity Before Getting Efficiency
8. Attempting to Separate Commodities Not Suitable for Gravity Separation

9. Using Insufficient Air
10. Using Excess Air
11. Belts Slipping

Try these simple steps to start a new Gravity:

1. While the machine is not in operation make the following adjustments by means of the jack screws at the high end of the machine. Loosen the clamps, make the adjustments, tighten the clamps.

Deck Adjustments	Machine No.	50	80	160
Difference in Short-Side Elevation		1 1/2"	1 3/4"	2"
Difference in Long-Side Elevation		2 1/2"	2 1/2"	5"

2. After being sure the BLOWERS ARE NOT TURNING BACKWARDS, close tight all the air gates. Directional arrow on end of machine.

3. Open the feeder to flow a small amount of seed approximately 4" - 6" wide. Without air, the seed will flow directly across the deck surface and "bank" against the cut-out gates along the upper side of the deck. Wait until this flow reaches the discharge at the end of the deck.

4. Adjust the eccentric speed to force the seed up-hill in a smooth travel. Too much speed will cause the seed to "jump" up-hill.

5. Gradually open the air-gates (two) on the Blower nearest the feeder. It will be noticed the seed will begin to slightly "boil" and the lighter elements will begin to separate and flow backwards.

6. Gradually open the air gates of the remaining Blowers until the lighter elements will begin to separate and flow backwards. Be careful of using excess air, otherwise all seed will flow backwards.

7. Continue making feed, and air adjustments, until the lighter elements are caused to flow along the "banking rail" along the lower edge of the long side of the deck. The deck surface should now be fully covered with an even bed of seed.

8. Beginning at the lower cut-out gate, gradually open these gates to allow the escape of clean seed over the upper long side of the deck. As the clean seeds escape through the cut-out gates, open the feeder to replace the same amount as the escaping seed.

9. Should the lighter elements commence to travel away from the banking rail, adjust by closing cut-out gates, or by increasing air, or by decreasing speed, or by increasing feed.

A short discussion of the common installation mistakes follows:

1. Gravity Installed on a Weak Foundation

A weak foundation is the cause of many Gravity failures. A slight

vibration at the base of the machine is multiplied many times on the deck. The Gravity is a reciprocating machine, and like all reciprocating machines, the Gravity must be secured to a solid foundation.

Weak foundations cause false vibrations which react adversely to the flow of the seed across the deck. False vibrations counteract the mechanical force of the eccentrics. Often the seed bed will surge, or flow in waves across the deck, when false vibrations become synchronized with the eccentric force. In other words, when the seed bed starts flowing in waves at regular intervals look for false vibrations. A good solid foundation pays big dividends.

2. Blowers Running Backwards

Blowers running backwards is one of the common mistakes in new installations. The function of the Blowers is to build a static pressure in the air-chest to insure an even air flow through the deck cover. The degree of this static pressure depends on the size of the seeds being cleaned, and the openings in the deck cover.

Notice the directional arrow on the feed end of the Gravity. The direction of rotation may be checked by removing the cover of the variable speed change pulley which is found near the directional arrow. The speed change pulley runs in the same direction as the Blowers.

Another method to determine correct Blower rotation is to remove the deck and start the machine. The fan wheels should be turning toward the fan opening. By opening one of the airgates the blower will deliver a strong air blast.

If a three phase motor is being used, simply change any two connections and the motor will run in the reverse direction.

3. Protector Over Air Filter Not Removed

The Gravity is shipped with a protection over the air filter. This is done to protect the filter during shipment and installation. The protector should be carefully removed so as to not damage the filter screen underneath.

4. Clean Air

The importance of clean air cannot be stressed too strongly as the success of the Gravity depends on a source of clean air. Dust laden air will soon close the meshes, or openings in the deck cover. Under such a condition the deck soon becomes inoperative, or "blinded". Blinded decks can easily be noticed by the seed bed appearing to be dead.

All Oliver Gravity Separators provide two means of introducing clean air into the machine. The built-in air filter is for use in locations having a limited amount of floating dust and chaff. If this filter requires cleaning too frequently, the air must then be taken from a more remote location.

A "nipple-panel" is shipped with each machine which fits any of the filter openings. Should outside air be necessary, the operator may use any convenient filter opening, however the diameter of the lead-in pipe should not be reduced otherwise the machine will starve for air.

Never attempt to clean an air filter while the Gravity is in operation. There is a strong suction against the filter screen and any attempt to brush, or remove the accumulation of dust particles adhering to the filter surface merely forces the smaller particles through the filter and quickly blinds the deck cover.

Even under favorable operating conditions it is necessary to frequently clean Gravity Decks. Some operators purchase an extra deck which can be quickly installed. The extra Deck insures continued operation with very little delay in cleaning Decks.

5. Loose Clamps

The operator will find two tie-rods running through each side of the air chest. The purpose of these rods is to rigidly clamp two plates which fix the air chest to the base of the Gravity. The clamps should be loosened before attempting to adjust either the side-raise, or the end-raise, and should be quickly tightened again. Loose clamps induce false vibrations.

6. Using Wrong Decks

The general rule for deck covers is: the smaller the seed, the smaller the opening in the deck cover. Conversely, the larger the seed, the larger the opening in the deck cover.

The above rule simply means that alfalfa, clover, and similar seeds cannot be efficiently cleaned on decks having large openings designed for cleaning beans, peanuts, peas, and like stocks. Use the right deck for a given size seed.

7. Trying to Obtain Capacity before Getting Efficiency

New operators often have a tendency to try for high capacities before taking the time to adjust their machine properly for efficiency. Efficiency should come first and increased capacity will naturally follow with experience. Once a Gravity is adjusted to function properly the matter of increasing its capacity becomes a simple matter.

8. Attempting to Separate Commodities Not Suitable for Gravity Separation

The Gravity is a "specialized" machine designed to separate two, or more, commodities of the same size but differing in specific gravities. Unless the commodity comes under this general rule, the Gravity becomes an inefficient machine.

9. Insufficient Air

The deck surface of the Gravity Separator is divided into two zones, a "STRATIFYING ZONE", and a "SEPARATING ZONE".

The stratifying zone lies in the deck area near the feed. Here the air jets stratify the seed according to their relative weights. The light weight seeds are forced to the surface of the seed bed while the heavier layer of seeds seek a location on the deck surface.

The separating zone is the remaining area of the deck surface after the seeds become stratified. The eccentric motion causes the heavier layers of seed to move up-hill. The lighter layers of seed not having contact with the deck surface are caused to flow downhill.

INSUFFICIENT AIR causes all seeds to flow up-hill similar to a deck surface badly blinded with dust particles.

10. Excess Air

The most common fault to be found with new operators is their tendency to use excess air. Excess air serves to lift the heavier seeds off the deck surface and to "blow" the heavier seeds through the stratum of lighter seeds. Excess air causes the heavier seeds to flow down-hill and report with the tailings. It is impossible to stratify the seed into relative weight zones and without stratification there can be no separation. The new operator who takes the time to adjust the air will find his time well spent.

11. Belts Slipping

Belt slippage is frequently another source of trouble, especially when starting the Gravity on a cold morning. "V" belts should not be rigidly tight which will cause excessive wear on bearings. Slipping belts cause an irregular flow of the seeds across the deck.

And while we are on the subject of cold mornings, at the start of the winter season it is good practice to tighten the bearing races on the shaft. Cold weather causes the grease in the bearings to thicken and the shafts to become slightly smaller. Shaft scoring is caused by the bearings sticking and the shaft revolving in the inner race of the bearing. A good inspection of the set screws fixing the bearing to the shaft might eliminate the trouble of replacing a scored shaft later.

New Operators

New operators often experience some difficulty in starting a Gravity. They have likely seen Gravities in operation with a full bed of seeds on the deck. They seem to get the impression that they can immediately duplicate the work by simply turning on the power and opening the feeder. Such is not the case as a Gravity Separator must be adjusted to each variety of seeds being cleaned.

MAKE ALL ADJUSTMENTS GRADUALLY. All gravities have the following adjustments:

1. Feed
2. Eccentric Speed
3. Air Control
4. Lateral Inclination of the Deck
5. Longitudinal Inclination of the Deck

The reason for making all adjustments gradually is because the Gravity does not respond quickly to any adjustment. A short time must be allowed before the effect of an adjustment can be noticed. After making the adjustment wait a few minutes to see what effect the adjustment made on the flow of seeds across the deck. Then continue with another adjustment until a satisfactory product is obtained.

Never make two or more adjustments at the same time, otherwise, the operator will not know which adjustment benefitted the operation.

Remember to first adjust for efficiency. Once the Gravity is adjusted to give the desired separations, the matter of increased capacity will follow.

Like every machine found in the Seed Cleaning Plant, the Gravity depends on the skill of the operator.

Gravity Operators Should Keep A Log Book

Most gravities are used to clean several varieties of seed during a season and each variety will require different settings of the various adjustments, Deck, Feed, Air, Eccentric Speed. For example, assume an operator is cleaning alfalfa seed this week. Next week he might be cleaning some other variety, say beans or grass seed. The Deck will require a slightly different setting for each different variety. After he has adjusted his Gravity to give him the best results, the operator should note the settings in a small note book for future reference, in this case under the heading "alfalfa seed". Suppose a month from now, or even next year, the operator is given another lot of alfalfa seed to clean. How handy it will be if he had a little note book which will give him the setting he previously used. Only a few minutes are required to make these notes and much time can be saved. His notes should give him the following information:

End-raise Difference _____	"	Deck Used _____
Side-raise Difference _____	"	
Feeder Opening _____	"	
Air Gate Opening _____	"	
RPM of Eccentrics _____	"	

The difference in end-raise, and side raise, may be taken from any convenient fixed point. The base of the machine may be used, or the distance from the floor to the high and low points of the Deck. The difference between these measurements will give him the difference in the Deck elevations.

The difference in eccentric speeds is not too important as an operator can instantly tell whether his Gravity is reciprocating too fast, or too slow, from the movement of the seed across the Deck.

The Stoner

The Stoner (Figure 3) is a Gravity because its operation depends first upon stratification of the particles in a mixture according to differences in their specific gravities. The upward flowing jets of air through the deck cover lift the lighter particles to the top of the mixture while the heavier particles sink through the mixture and come to rest on the Deck surface. The particles therefore quickly form "zones", or layers, according to differences in their relative weights.

The heavier particles, being in contact with the Deck surface, are caused to move uphill by the eccentric force. The lighter particles, floating on a film of air, flow backwards and are discharged along the wide edge of the Deck.

It can be seen from the above statements that the air adjustment is most important. Excess air will cause all particles to flow downhill. Insufficient air will cause all particles to flow uphill by reason of being in contact with the deck surface and being acted upon by the eccentric force.

The area of the Stratifying Zone depends on the difference in the specific gravities between the particles being separated. A mixture having a wide difference in specific gravity, for example stones from wheat, the Stratifying Zone is relatively small. The Stratifying Zone increases in area as the feed is increased, however, the Stratifying Zone should never exceed more than one-third the total area of the Deck. Otherwise, the smaller bits of the heavier elements will not have sufficient time to contact the Deck surface and will tail over with the lighter elements.

The pattern in Figure 4 illustrates an operating condition which frequently occurs. A heavy area forms slightly short of the throat and only the larger of heavier particles travel upward. The smaller heavy particles tail over with the lighter. This condition may be caused by the following:

EXCESS AIR. This is the most common cause. Only the largest of the heavy particles will accumulate along the fringe edge of the lighter particles. This condition is corrected by reducing the air pressure.

DECK TILTED TOO HIGH. The heavier particles are only pushed upward by the mass behind them.

SLOW ECCENTRIC SPEED. Increasing the eccentric speed will cause the heavy particles to travel upward, providing the tilt, and the air adjustment, has first been properly made.

The illustration in Figure 5 is also one frequently seen among Stoner operators. Here the operator is allowing the lighter particles to travel too close to the discharge of the heavier particles. The lighter particles become entrapped in the heavier and are discharged with the heavier. The result is a mixture being discharged from the Deck. A more careful adjustment of the machine will produce cleaner products of each.

The sketch shown in Figure 6 is an ideal pattern. Notice the Throat of the Deck is entirely covered with the heavier particles. The gate across the discharge is kept closed until a sufficient amount of the heavier particles accumulate to cover an area 8" - 10" from the discharge edge. The gate is then opened, or adjusted, to allow an equal amount of the heavier particles to escape as are being fed to the Deck.

MAKE ALL ADJUSTMENTS GRADUALLY AND WAIT A FEW MINUTES TO NOTICE THE EFFECT OF THE CHANGE.

Figure 7 is a sectional diagram of what occurs on a Stoner Deck. Compressed air forced through the meshes of the Deck cover lift the lighter particles upward while the heavier particles sink against the air currents and come to rest on the Deck surface, providing the air is properly adjusted. The heavier particles are forced to travel forward, by mechanical action, while the lighter particles float backward on a film of air.

We have often heard operators of Stoners argue as to the proper location of the Feed. Many different theories are advanced.

The proper location of the Feed depends on the mixture being separated. Here again the Stratifying Area is the important factor. If the Feed is too far down the Deck, the particles are discharged before having an opportunity to become thoroughly separated into zones. If the Feed is too far forward, the lighter particles become trapped in the heavier particles and a "ragged" heavy product is made.

While Stoners have greater capacities than Gravities, based on square feet of relative Deck area, there is a limit as to the amount of Feed flowing to the Deck. As the Feed is increased, the Stratifying Area is also increased. The Stratifying Area should occupy not more than one-third of the entire Deck area.

Samples should often be taken of the two products and closely examined. If small heavy particles are being discharged with the light, the Feed should be moved slightly forward, or the amount of the Feed reduced.

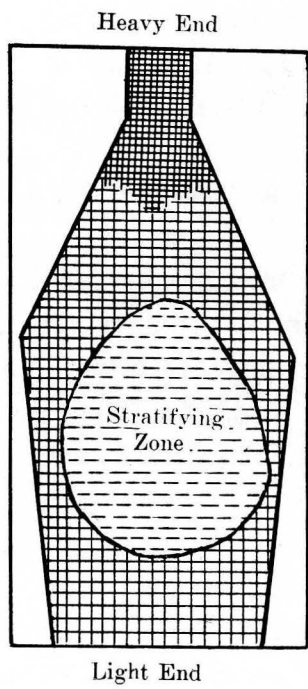


Figure 3

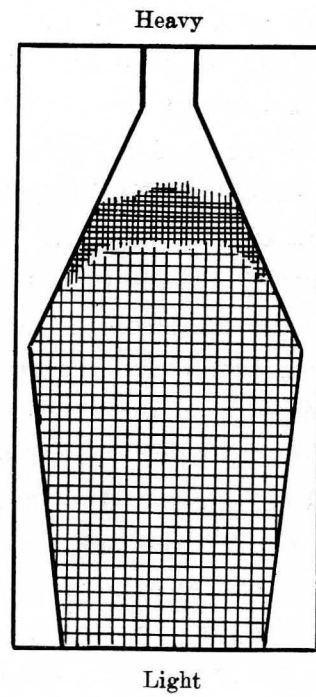


Figure 4

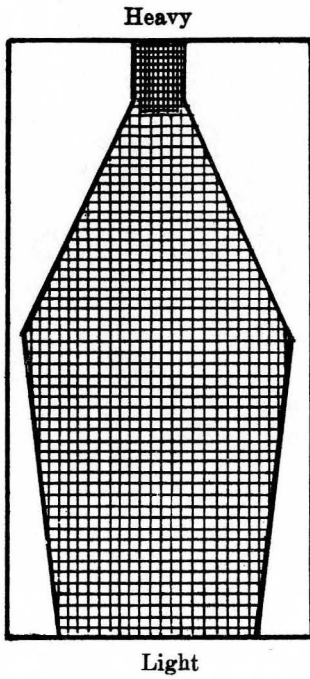


Figure 5

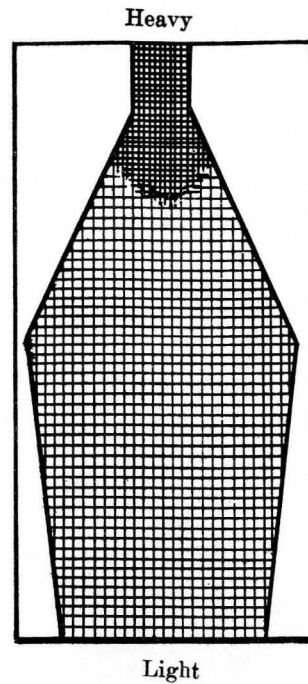


Figure 6

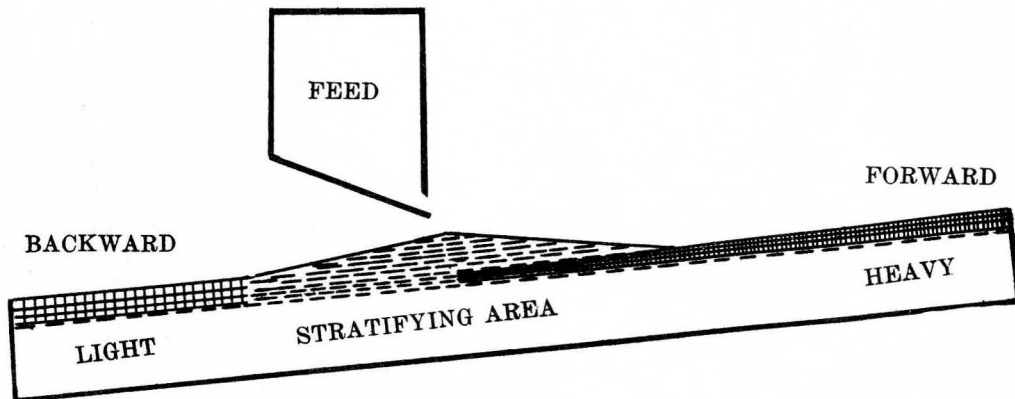


Figure 7