Screening Functions

All present day vibratory machines have their roots in "screening" units. More than 200 years ago, they met an essential need in the emerging cement and grain industries. Crudely constructed, steeply downhill sloped, slow moving "shaker" type screens were used in cement making processes as early as the 1770's. They "shook" with virtually an arbitrary motion. Gravity was relied upon to cause the material to roll down and over the screen media. Full length collecting hoppers for the "unders" were mounted underneath the shaking screen deck. Conversely, the first practical machines to move bulk solids by solely a conveying type vibratory action did not appear until more recent times. This background still has a strong influence on the different types of vibrating screens available today and their application practices.

Vibrating screens are essentially conveying units equipped with some kind of screening media. Since the generated vibration is the prime mover of the material over the screen's surface, they are an "Induced Conveying" type of vibratory machine.

After the decision was made to adopt the Kinergy Drive System to them in 1978, it eventually came to be recognized as the most significant advancement in vibrating screens that had been accomplished in more than 40 years!

Screening Functions

There are many different uses for Kinergy Driven Vibrating Screens. Some of them are:

Cleaning "Unit Pieces": These are single screening deck units that rely on the vibration to remove clinging particles, trim edges, or anything similar from "unit pieces" (Figure 1). Examples would be the cleaning of the various types of briquettes, pressed logs, dried pellets, or shaking off adhered sand from metal castings.

Washing: By mounting rows of liquid sprays directly over the screen medium, a bulk solid or a unit piece can be "washed" while it is being conveyed (Figure 2). The liquid spray can be water, oil, liquid detergent, a chemical solution, or the like. Sometimes one or more of the "sizing" functions is combined with this cleansing operation. This same kind of "washing" action is often used to spray the exposed "overs" retained on deliquifying screens.

Sizing: This is the separation of Flake, Floodable, or General type bulk solids on the basis of their dimensional "size". To apply these units, a reasonably accurate "sieve analysis" of the material to be screened should be available to Kinergy.

This screening function is based upon the inherent "stratification" of the particles as they are conveyed. The incoming material normally does not drop directly onto the screen media. Consequently, a short conveying trough section is added to the unit's inlet end, which acts as a "feed box", as shown in Figure 3. It needs to have a steady supply of the bulk solid with a reasonable "spread" across the width of the screen.

If the bulk solid has an excessive moisture content combined with the need for a very small "size" separation, a group of water sprays may be required to avoid blinding the screen medium. When this is done, it is called "wet screening" and it is depicted in Figure 4.

Fig. 1: A typical screen for "cleaning" briquettes.

Fig. 2: "Washing" the retained solids on a deliquifying screen with "hinter" type spray nozzles.

Fig. 3: A typical "sizing" screen. Note the "feed box" at the inlet end and the "discharge lip" at its outlet.

Fig. 4: When "sizing" bulk solids with a high moisture content, "wet screening" may be required. The needed stationary piping and water sprays are shown on this unit. The collecting hopper underneath does not vibrate.

Scalping: This is the removal of markedly "oversize" particles. The "accepted" sizes are usually the ones that pass through the screen medium. The incoming material is at least 50% of the "half size" content. Of the "sizing" functions, this is the easiest to accomplish.

Removing "Undersize": This is also called de-dusting, fines removal, or shaking out the "small size". The "acceptable" particles are normally those that remain on top of the screen. The unit usually has a single screening deck, but it can be equipped with a second one to improve its efficiency.

Grading: This is a close "particle to particle" or "particle from slivers" type of separation. It is the most demanding of the "sizing" functions.

Typically, a minimum of two screening decks will be needed and many times, three or possibly more will be required. If it's a Unidirectional conveying unit, the upstream and downstream ends are completely "open" across their width as a basic unit. Of course, either or both ends can be enclosed as they are when the unit is to be "dust-tight". Conversely, Circular screens are inherently enclosed around their periphery.
**Deliquefying:** When a liquid engages a vibrating surface, it tends to "implode". This internal implosion is opposite to an external explosion. The implosion reduces the liquid's "surface tension". This highly "localized" internal pressure rise tends to free the bulk solid particles from the surrounding liquid. Imploding is the basic phenomenon that makes "deliquefying" practical with vibrating screens. It is used to remove excess surface moisture from a very wet, lumpy "General" or a "Flake" type of material. For example, the shedding of water from a bulk solid by a vibrating screen prior to a drying operation to reduce the quantity of heat required. "Unit pieces" can be deliquefied in the same manner. Another is the separation of solids from a slurry. The content of these slurried solids is mostly very fine particles which would be "floatable" if they were dry. Usually, deliquefying units have only one screening deck as pictured in Figure 5.

**Air Classification:** Sometimes the particles to be removed are too light in weight to permit an efficient vibratory separation. When they are, forced or induced air is purposely added to "lift" them up and out of the material as it conveys along or discharges. This is called "air classification" and a typical unit is illustrated in Figure 6.

**Desliming** is washing the clinging "fines" from freshly crushed lumpy "General" materials by conveying it under a liquid spray and recovering the resulting slurry. The fine particles are later extracted from the slurry when they contain valuable minerals such as gold, silver, copper, or the like.

**Rinsing** is virtually the same as washing for removing adhered fines from lumps.

**Dewatering** is the removal of free water or excess surface moisture from a bulk solid or unit pieces.

**Draining** is the conveying of the material over a screen section to allow the excess water to "drain" off.

When a "sizing" function is also needed, or the percentage of solids in the liquid is relatively high, a second screening deck will most likely be required.

**Mold Shakeouts:** These are single deck screening units that accept a solidified mold after it has been "punched out" of its containing flasks (Figure 7). Sometimes, the unit must contend with the entire cast mold which means the flasks are included. Its function is to break up the packed or cohered mold to free the metal casting embedded inside, and to reduce the resulting large lumps of sand so they will pass through a given size opening in the casting deck's screen. If the sand lumps are to be reduced to a relatively small size, two decks of screen media could be required. Almost always, the revealed casting needs to be conveyed to a specific side of the unit to facilitate its further handling. The space above the top of the unit should be unobstructed to enable the "mold dumping" operation. Normally, this is one of the few types of screening units that has to contend with a potential high shock or impact loading.

![Fig. 6: Sometimes the separation of light weight "Flake" or "General" type materials needs to be done with "Air Classification" on a unit similar to the one shown here.](image)

**Recovering Mold Sand:** After the shakeout sand has been retrieved, it needs to be cleaned and reduced in size so it can be re-used. When it's done, "cleaning" amounts to removing core butts, scrap metal, and lumps from the shakeout sand. Other functions are:  

- **Green Sand:** Lumpbreakers equipped with the appropriate screen medium openings reduce this previously "baked" mold sand to an acceptable smaller size (Figure 8).  
- **No Bake** Sand: Mold sand of this type has a strong chemical bond. If it is to be reduced to only "grain" size, an Attrition Mill equipped with the appropriate screen medium would be used (Figure 9).  

- When most of the small and lighter chemical particles are also to be separated from the sand grains, air classification is added to the screening function. This is needed when the "LOI" (loss on ignition) is to be minimized, and the unit to do this is known as a "Sand Reclaimer".

**Fig. 7:** Foundry Mold Shakeouts are vibrating screens of more rugged construction.

**Separating Scrap Metal From the Shakeout Sand:** This unit removes the shakeout sand and lumps from the sprues, gates, risers, flashing, or other metal fragments that were derived from the previous metal pouring.

![Fig. 8: When "green sand" in a Foundry needs to be reduced in size and cooled, a lumpbreaking conveyor type screen is sometimes used.](image)

![Fig. 9: An Attrition Mill for "no bake" type shakeout sand in a Foundry. When the screening function is coupled with air classification, it is called a "Reclaimer".](image)
Screening Efficiency

Nomenclature

Efficiency of Screening
Expressed as a percent, it is the ratio of the amount of material actually passing through the screen's openings as compared to the total amount of undersize material in the incoming feed that would be able to pass.

Nomenclature
Vibrating Screens are a unique induced Conveying machine. Therefore, some of its related components should be reviewed.

Feed Box: This short length conveying trough is utilized at the inlet end of the unit whenever the incoming bulk solid needs to be "stratified" (Figure 10). It also avoids abrasive wear from impacting and the unnecessary blinding of the screening medium on its upstream extremity.

The "feed" to the screening unit needs to be uniform and with a reasonable spread across its width.

Screen Body: This is the vertical side walls or the complete conveying trough assembly of the screening unit.

Screen Medium: The screening surface that is equipped with openings which are also called "apertures".

Typically, it is woven wire, perforated plate, profiled wedge wire or bar, or grizzly bars. Other screen media includes UHMW type polyurethane, harp wire, and rubber.

Electrical heating of the screen medium may be required when "sizing" General type bulk solids which have a high moisture content.

Securing the Screen Medium: The most popular method is longitudinal "clamping bars" passing down each side or around the screen body. For their quick removal, they can be supplied with hammer hit "wedges" to loosen or tighten their bolting. Wooden wedge clamping can also be utilized (Figure 13).

Other methods such as vertical bolting or sanitary screen media "inserts" can be provided when they are needed.

Screening Deck Supports: This is an independent structural entity that supports the screening medium (Figure 14). In most instances, it is a complete or sectionalized assembly that bolts to the sides of the screen body.

Ball Cleaning: By rigging small compartments directly under the screen medium and inserting spherical balls in these retained "pockets", a ball cleaning deck can be constructed. The balls bounce up and strike the underside of the screen medium above (Figure 15). They tend to prevent the blinding of the screen medium from "near size" particles getting stuck in the very small openings.

Liquid Sprays: These are added to screening units when washing, wet screening, desliming, or something similar is an added function. Sometimes these sprays are through holes drilled in the side wall of pipe. More often they are nozzles of either the "fish-tail", spherical, or with a spray pattern as needed (Figure 16). Nor-
mally, the sprays and their respective plopping are mounted stationary and do not vibrate. Quite often, the “user” of the screening unit supplies this feature, but it can be provided by Kinergy when it is wanted.

**Access Openings:** A unidirectional, multi-screening deck unit needs access openings that are appropriately located on each side to enable the changing of the screen media (Figure 17). If the unit is dust-tight, “view ports”, which are windowed doors secured by quick release handles, permit the easy observation of the screening operation.

![Fig. 17: Open holes or an enclosed “view port” door with quick release clamps are used for access to unidirectional units.](image)

**Discharge Lips or Spouts:** At the downstream end of the screen medium, an abbreviated conveying surface is often needed. It is called a “discharge lip” on Unidirectional units and it enables the transfer of the material to a chute or another unit. Another term used in this regard is a discharge spout.

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**Conceptual Comparison**

Almost all vibrating screens were previously driven by the “Single Input” type of vibratory drive system. It relies solely on the motor to provide all the needed power. This is more commonly known as “Brute Force”.

Typically, unidirectional units utilized very large rotating eccentric weights mounted on a “jack shaft” which is turned by a vee belt connection to an electric motor. Consequently, the driving dynamic forces are concentrated at one point and the needed big bearings often require sophisticated lubricating methods.

Examples of these types of previously known screening units are as follows:

**Unidirectional Inclined Screens:** This kind of vibrating screen was introduced around 1912. It develops a “circular” or an “elliptical” stroke pattern. They are often called “single shaft, two bearing” units quickly found application in the ore processing and coal preparation plants (Figure 20). In addition to “sizing”, their horizontal mounting made them appropriate for desliming, dewatering, and the drain and rinse functions. The “Single Input” or Brake Force type of vibratory drive system had two shafts with counter-rotating eccentric weights. This is why they are often called “two shaft, four bearing” screens. While higher in initial cost, it requires less head room. The linear stroke pattern causes less wear on the screen media.

![Fig. 18: 1910 A typical “inclined screening” unit. It has a single shaft with a rotating eccentric weight that passes through the screen body. They are sometimes called “two bearing” screening units.](image)

**Unidirectional “Sitter Stroke” Screening Units:** A very shallow stroking unit was developed in the 1920’s. Its unique movement is a “sitter stroke” type of vibratory action which is beneficial for separating “slivers” from particles and some “sizing” separations of less than 30 mesh (Figure 19). Observing the unit from the side, it is seen to develop a low angled, linear stroke. They are utilized by the Food, Grain, Fertilizer, and Wood industries. Probably to minimize the maintenance required by the big bearings, most of them operate at very slow speeds (frequency) and very long strokes. Typically, it would be a 3” stroke at 250 RPM (CPM).

![Fig. 19: 1920’s A typical “single Input” (brute force) driven, horizontal mounted screening unit. These are sometimes called “four bearing” units.](image)

**Circular Screens:** These screening units were introduced around 1949. Underneath the screening section, a vibratory motor, with double-extended shafts, is mounted vertically (Figure 21). By manually adjusting the rotating eccentric weight installed on each motor shaft, the circular conveying speed can be varied. The screening decks can be stacked to about 5 high. Since the driving forces are concentrated at one point, they are usually limited to a maximum diameter of 6 ft. These were the first vibratory machines to use an electric motor that was specially designed to successfully endure the continuously reversing, cyclic stresses associated with vibration.

![Fig. 20: 1930’s A typical “single Input” (brute force) driven, horizontal mounted screening unit. These are sometimes called “four bearing” units.](image)

![Fig. 21: In about 1949, the circular screen as shown came into being. It was the first to use a vibratory motor specifically designed for vibratory service.](image)
The Kinergy Drive System

Combining a "Free Force" input from an A.C. type electric motor with the output of "Sub-Resonant" tuned springs describes the Kinergy Drive System. When the applied load increases, the springs inherently drive harder. Stated differently, relatively small rotating eccentric weights installed on the extended shafts of a motor sustain the vibratory motion of reactive power producing drive springs (Figure 22). Their output can be electrically controlled over a very broad range.

It maximizes the use of "Kinergy", which is defined as the kinetic energy developed by a spring's motion during the drive portion of its cycle. This is why it is commonly called the "Kinergy Drive System", and vibratory machines using it are said to be "Kinergy Driven".

For powering screening units and all the other "Induced Conveying" machines, it has proven to be the most versatile and "energy efficient" vibratory drive system known.

![Stabilizer](image1)
![Drive Spring](image2)
![Vibratory Motor](image3)

**Fig. 22:** The Kinergy Drive System has only three component parts. The steel coil drive spring that produces "Kinergy", the stabilizer to guide it, and the motor that supplies the needed heat energy to sustain the vibratory motion.

**Circular or Unidirectional Screening**

Kinergy Driven Screens are most often "Unidirectional" in their conveying path. This means the material is being conveyed in a single direction.

Circular screening units develop a helical type stroke action which conveys the material around in a circle in the horizontal plane. When a lifting or lowering of the material is also needed, the screening unit is designed similar to a Spiral Elevator.

**The Vibratory Action**

The stroke pattern for all Kinergy Driven Unidirectional Screens is uniformly "linear" or a straight line (Figure 23). Circular units have a uniform "linear" stroke around their periphery.

The stroke angle will vary from being shallow for, say, "Sifter Stroke" units to being very steep as is required for some foundry mold shakeouts. The resulting "Gee" force is directly proportional to the length of the stroke and the "square" of the operating frequency.

It has long been known that a high frequency, short stroke type of vibratory action generates an intense "surface" action, but sacrifices "mass penetration". Whereas, a much lower frequency, long stroke vibration has the advantage of penetrating a very deep "mat depth" with a markedly reduced "surface action". From this guideline, operating frequencies of 570 CPM are a minimum and higher frequencies to 1740 CPM are utilized for Kinergy Driven Screens.

As a practical example, a very deep mat depth of a bulk solid can be successfully screened through a 1" opening at 570 CPM. Conversely, to achieve extremely fine screening with an opening measured in "Microns" or in the 400 mesh range, a thin layered mat depth and a much higher frequency, such as those used in electronics, could be needed.

**Adjustable Output**

By adding a "Variable Voltage" type of electrical controller, the operating stroke and frequency of any Kinergy Driven Screen can be simultaneously changed. The unit's output can be adjusted from "zero to maximum". It allows some screening units, such as those used for scalping, to also act as feeders. Automatic and abrupt "pulsing" is possible. It is the temporary application of a longer stroke, at a higher frequency, to either clean the screen medium or to improve the effects of screening.

The "Variable Voltage" controller can be a manual auto-transformer, but it usually is an SCR (Silicon Controlled Rectifier)

because it has more operating flexibility (Figure 24). Both have an A.C. input and output.

**Fig. 23:** The stroke patterns.

**Fig. 24:** The two different types of "Variable Voltage" electrical controllers.

**Location of The Drive Assembly**

Before Kinergy Driven units became available, almost all vibrating screens utilized the "Single Input" or the so-called "Brute Force" type of drive system.

Consistently, the two bearing, inclined unidirectional screen had its single shaft pass through the screen body between the screening decks or it was mounted above the top deck. The "four bearing" unit usually had its two shafts mounted above the screen body. In either instance, the bottom of the screening unit was left entirely "open". The "unders" fell into a steep walled, stationary collecting hopper. This drive design practice could create the impression that most Unidirectional vibrating screens should be supplied with a "top drive" arrangement with the screen body completely open on the bottom.

Another example is the previous Unidirectional "Sifter Stroke" screens. With their limited lengths, and vibrating very slowly, they almost always had their drives mounted on the inlet end. This has been their earmark for about 70 years.

Conversely, Circular screens which also used the "Single Input" type of drive normally had it located underneath the screen body.

Supplementing these traditional design and application guidelines, which have existed for many years, is the Kinergy Driven Vibrating Screen. The beneficial difference is the extra latitude in design and operation this advancement has made possible.

For this reason, the various options for the drive system location need to be reviewed.
The Advantages of Kinergy Driven Screening Units

Bottom Drive: The vibratory drive system is located underneath the screen body as shown in Figures 25 and 26.

The bottom drive arrangement is always recommended for all Kinergy Driven Screens.

Although the unit will weigh more with the drive system on its underside because of the added bottom frame, it permits better access to the screening decks, makes it easier for "dust-tight" screen body construction, and it eliminates the need for the steep wall "collecting hoppers" underneath.

Since it represents a gainful preference, "bottom drive" locations are always recommended for both Circular and Unidirectional screening units.

Top Drive: The drive system is above the screen body (Figure 27). Typically, the underside of the screen unit is completely open to permit the discharge of the "unders" along its length or around its bottom. This reduces the unit's overall weight.

When used with liquid sprays, the drive spring brackets can be arranged to accommodate this feature. If it is needed,

a full length "unders" conveying trough will be supplied. This adds weight, but it makes the unit more readily adaptable to being "dust-tight".

End Drive: When head room is severely limited, Unidirectional vibrating screens with the drive system on either end can be provided. This is sometimes called a "low profile" design (Figure 28). Since all the drive forces are concentrated on one end, it could limit the screen body's length to about 12 ft. It can be provided with an open bottom or a full length "unders" conveying trough. The latter facilitates a "dust-tight" unit. This drive system location provides full access to the screening surfaces.

Larger Dimensions

Since the Kinergy Drive System "distributes" the input dynamic forces, the diameter or length and width dimensions are not restricted as they would be if they were "concentrated" at one point.

This is the reason Kinergy Driven Vibrating Screens that are Unidirectional are standardized in widths to 12 ft. and lengths as required as depicted in Figure 29.

Circular units can now be built to at least an 18 in. diameter.

Circular units are available to 18 ft. in diameter for the same reason. Namely, the helical motion producing drive springs are "distributed" around the circumference so the structural integrity of the circular unit is readily retained.

The Advantages of Kinergy Driven Screening Units

Adapting the Kinergy Drive System to vibrating screens has provided a long list of beneficial gains.

Dust-tight Construction: The screen bodies can be made "dust-tight". It is a practical option, especially for units equipped with a bottom drive assembly. For Unidirectional units, both ends are enclosed, a full length cover added, and the separations are discharged down through individual vertical chutes (Figure 30). Flexible connections are needed at the unit's inlet and outlets.

Energy Efficiency: The power consumed will be 70 to 80% less. This conserves energy and it markedly reduces operating costs by saving about $300/HP/year. It combines the "Kinergy" produced by the drive springs with the input of the motor to power the vibrating screen. This is why they are so "energy efficient" (Figure 31).

Quite often a "cash rebate" will be granted by the local Electrical Utility company for the use of a Kinergy Driven Vibrating Screen because it makes a marked reduction in the amount of power being consumed for a given screening function.

Circular units are the most "energy efficient" units available. This 8 ft. wide x 27 ft. long, horizontal four-deck unit grades three sizes of coal at a rate of 350 TPH. It only consumes 10 HP.
The Advantages of Kinergy Driven Screening Units

(continued)

Support: All of these screening units are inherently “counterbalanced”. This reduces the cost of their supporting means because it does not have to be so robust and heavy. Soft steel coil springs are normally used, but solid rubber can be supplied when it is needed for the isolators. Even though most screening units are considered to have “steady state” loading, they are always recommended to be supported from underneath. When it is absolutely necessary, they can be suspended from above by, say, steel cables connected to their counterbalances. Unidirectional units with an end drive will require a sub-structure under the vibrating screen when overhead suspension is required.

Operating Flexibility and Versatility: By taking advantage of the inherent adjustable output, the screening unit can have its operating stroke and frequency automatically “pulsed”. This can be used to minimize the blinding of the screen media. For some screening applications, the unit can also serve as a feeder.

Minimal Components: Only three components make up the Kinergy Drive System: flat bar type stabilizers, steel coil drive springs, and the vibratory motor. On some light weight designs, the steel coil type drive springs are omitted. Any of these components can be changed in less than one hour by two mechanics possessing reasonable skills. This minimizes the down time in that regard.

Installed Mounting: Their linear stroke output gives unidirectional screening units versatility in their installation. It can be horizontal, declined, or the screening medium can be slightly inclined uphill.

a. Most unit piece cleaning units are mounted horizontal.

b. For "sizing" functions, the units can be mounted horizontal. To further reduce the input power required per tph screened, they can be sloped downhill to 20°. When a choice can be made, a 10° decline is suggested because it allows more versatility in the type of screen medium that can be readily used.

c. De-liquefying screens almost always have their medium inclined uphill 2 to 3 degrees. When the bottom drive arrangement is utilized, the liquid collecting trough underneath slopes downhill at least 5°.

d. Mold shakeouts usually have the casting deck sloped uphill when they are Unidirectional, but their underside sand conveying decks are horizontal. The mounting of the machine is also horizontal as it is for Circular shakeouts. Circular screens almost always have their screen media mounted horizontally.

Reducing Wear: The screen media will have a longer life. The "linear stroke" accomplishes this benefit because this type of vibratory action reduces "sliding" abrasion.

Smaller Bearings: The large bearings and their often used lubrication systems are eliminated. Another plus is a faster operating speed (frequency) for "sifter stroke" units which enables more efficient screening.

Smooth Starts and Stops: The severe wobble at starting and stopping by previous screening units has been eliminated. No "snubbers" are needed.

Low Sound Level: The screening units operate very smoothly and quietly. Typically, less than 60 dB(A) when in the "no load" or empty condition. Under "load", they seldom exceed 80 dB(A).

Their quiet operation means that any extraneous noise should not be tolerated. Its source should be traced and eliminated. Usually the difficulty will be found to be a loose drive spring bolt. This illustrates the "look and listen" principle of maintenance. Simply "listen" to the unit in operation and "look" at its operating stroke. Aside from the occasional greasing of the motor, that is all there is to do for the proper maintenance follow.

Minimal Maintenance: By eliminating the big bearings and their high degree of force concentration, and the use of components specifically designed to endure the vibratory action, the maintenance requirements for these vibrating screens has been markedly reduced.

Increased Dimensions: Since the driving forces are "distributed" around the diameter or across the width and along the length of the screen body, any previous design restrictions with regard to these dimensions have been removed. This allows the unidirectional screens to be offered in widths to 12 ft. in standard designs, and with lengths as required. Some "end drive" units may be an exception because of the necessary concentration of the drive springs. Circular units can have diameters to 18 ft. as a standard.

Interchangeable Parts: For a given service rating, such as heavy duty, most of the component parts of the drive system are interchangeable with other Kinergy Driven units even though their functions may be different. These common components extend to Feeders, Conveyors, Fluid Bed Coolers and Dryers, Spiral Elevators, and the various types of Foundry units. This reduces the number of spare parts required.

Easy Start-up: Each Vibrating Screen is factory tested in the "no load" condition prior to shipment. Aside from confirming the motor's proper direction of rotation at "start-up", usually nothing further needs to be done. If, by chance, mechanical field tuning is required, it simply amounts to adjusting the motor's rotating eccentric weights and bolting "tuning plates" or possibly adding or subtracting a drive spring (Figure 32).

Fig. 32: If mechanical adjustments at "start-up" are needed, they are easy to do. The bolting of "tuning plates" to the frame or adding eccentric weights to the motor is readily accomplished.

Simply the Best: With no more than three component parts, the design of the drive system is about as "simple" as it can be.

The optimum stroke angle, smooth and quiet operation with only minimal maintenance, less screen media wear, adjustable stroke and frequency which enables "pulsing", and the highest degree of energy efficiency combine to assure the "best" performance level.

Coupling this "simple" design with the "best" performance rating makes Kinergy Driven Screens "Simply the Best".

Unidirectional Screens

All unidirectional vibrating screens are offered with the drive system location on the bottom (recommended), top, or on either end for a "low profile" configuration. They all develop a "linear" type stroke. Depending upon the application, the stroke angle will vary from shallow to being very steep. Widths are to 12 ft. as a standard, with lengths as required.
Economical, light weight Vibrating Screens that stroke to \( \frac{3}{8}'' \) @ 570 CPM or about 3 "Gees". They are usually limited to one screening deck. The density of the screened bulk solid should be about 30 PCF or less.

Available in widths from 4" to 60" and in the required length, they are constructed of 14 and 12 ga. mild steel or stainless. Normally, steel coil drive springs and isolators are used. When it is required, fiberglass flat bar type drive springs combined with solid rubber isolators can be supplied. Sanitary units with the appropriate inside and outside finishes can be provided. The drive system location will be bottom (recommended), top, or on either end for a "low profile" type. "Dust-tight" screen bodies are optional.
These Kinergy Driven Screens usually stroke \( \frac{3}{8} \)" @ 855 CPM, but they can be 570, 1140, or 1710 CPM with an equal 4 "Gee" force. They should be used when the screen material is less than 50 PCF density.

Available in widths from 12" to 96" and in the length required, the screen body is constructed of \( \frac{1}{8} \)" to \( \frac{1}{4} \)" thick mild steel. Other alloys and stainless steel can also be provided.

When required, sanitary units with appropriate inside and outside finishes will be provided. This includes the omission of any steel coil springs. Instead, flat bar type drive springs and solid rubber isolators are supplied.

Undersupport is always preferred, but overhead suspension can be used. The drive system location will be bottom (recommended), top, or on either end for a low profile design. "Dust-tight" screen bodies are optional as are the various liners.

The largest SD unit in productive service, it is 54" wide x 90" long! It screens shelled almond nuts. It consumes 3 HP.
A Screening Feeder with a dump hopper.

A typical rear or front access door in a dust-tight unit to enable the changing of the screen media.

A "Sitter Stroke" unit with a bottom drive. 1.4 HP

30" wide x 20' long. 2 HP
Rugged vibrating screens that usually stroke \( \frac{3}{4}" @ 855 \text{ CPM} \) but they can be 570, 1140, or 1710 CPM with an equal 4 Ghee force. Higher “Ghee” forces are available by special design. These units are normally used when the screened material exceeds a density of 50 PCF.

Widths are available from 12" to 12' as standard, in the length required. Construction can be mild steel, alloy steel, and stainless steel.

Undersupport is always recommended, but when it is absolutely necessary, overhead suspension can be used provided a “steady state” loading is the situation. The Kinergy Drive System location will be on the bottom (preferred), top, or on either end for a low profile design. “Dust-tight” screen bodies are optional and so are the various liners.
Heavy Duty Screens
Shakeouts/Attrition Mills/
Sand Reclaimers

These Kinergy Driven Foundry units normally stroke \( \frac{3}{8}'' \) @ 855 CPM, which is 4 G's of output force. Widths are available from 24 inches to 12 ft. as a standard. Undersupport is always recommended but, on occasion, they can be secured by their counterbalance when it is above the load member.

- 5' wide x 21' long, 5 HP
- 30' wide x 24' long, 2 HP
- 6' wide x 10' long, 2 HP
- 42' wide x 12'-6' long, 4 HP
- 6' wide x 8' long, 3 HP
- 96' wide x 22' long single deck, top drive, horizontal, 10 HP; Cleans shakeout sand in a Foundry at 400 TPH.

Sand Reclaimer
Attrition Mill
Extra Heavy Duty Screens

These are strong and robust screening units for handling heavy weight boulder type materials or big molds. A typical application would be the efficient screening of large rocks prior to primary crushers or as very large mold shakeouts containing heavy steel castings. They have the advantage of the Kinergy Drive System's ability to successfully contend with abusive shock and high impact type loading.

A 5 ft. wide x 15 ft. long Foundry Mold Shakeout that has a 5 HP input.

This 5 ft. wide x 29 ft. long unit has screen media that is 1 inch thick alloyed steel. It screens hot sinter in a steel mill at a rate of 100 TPH.

A 10 ft. x 12 ft. Foundry Shakeout. It shakes out cast molds, which includes flasks, to weights of 35 tons. The power consumed is 15 HP.

When Primary Crusher Feeders require a reasonably efficient level of screening, the required "screen area" must be available to accomplish it.

Cleaning steel castings and despruing
Circular Screens

All Circular Screens are supplied with the drive system on the bottom (preferred), top, or around the vertical side wall’s periphery. They all develop a helical type stroke. Depending upon the application, the stroke angle around the circumference of the unit will vary from shallow to being very steep. Units are available to 18 ft. diameter as a standard. They should be used when unidirectional advancement is not wanted, space is limited, or more retention time on the screen is beneficial.

**Light Duty:** Economical, lightweight Circular Screens which have a reasonable level of vibrating intensity. They are used for the less demanding functions such as unit piece Cleaning, Washing, Scraping, and Draining bulk solids to about a .30 PCF density.

**Standard Duty:** Circular Screens which have a high intensity action on the screen’s surface. For bulk solids with densities to 50 PCF, they can be used for Cleaning, Sizing, Deliquefying, or as smaller mold Shakeouts which have relatively light weight castings.

**Heavy Duty:** These are rugged screening units for handling bulk solids in excess of 50 PCF density. They provide a high intensity vibratory action on the screen’s surface. These units are typically applied for some Cleaning needs, “Sizing”, Deliquefying, or for mold Shakeouts containing aluminum, brass, or steel castings. Attrition Mills and Sand Reclaimers are also popular units.

**Extra-Heavy Duty:** Since the Kinergy Drive System can tolerate a high impact, shock type loading, extra-heavy duty Circular Screens are now available. They should be used whenever an application warrants their use. A good example would be as a shakeout for very large molds because the resulting sand lumps would be more readily retained on the casting deck for as long as is needed to reduce their size.

A popular application for circular screening is the Foundry Sand Reclaimer. It accepts a “batch” dump and the grain size passes through the screen in the unit’s lifting track. The balance recirculates. Air classification is added when it is required to reduce LOI.

By adding volumetric capacity, "batch" dumps can be screened.

Circular troughs are sometimes needed.

When the lifting (shown) or lowering of the material is also needed, the Circular Screening unit (shown at right) is designed similar to a Spiral Elevator.
Sanitary Designs and Polished Finishes

Either the Circular or Unidirectional Screens can be supplied with sanitary designs. This usually means stainless steel construction, inserted type screen medium, and solid rubber isolators, along with the "clean lines" of the unit.

Virtually any internal or external finish can be provided. The welds can be "power tool cleaned", "ground smooth but not flush", or "ground smooth and flush" with a polished uniform stripe with a specified grit, such as 150. The surfaces can be hand-polished to, say, a No. 4 finish. So-called "Dairy" finishes or the 3-A sanitary standards which combines the USDA, the manufacturer, and the end user, can also be provided (Figure 33).

Fig. 33: Polished finishes (above) are available. Also, inserted screens (as shown below).

Testing

While running screening tests at the site of actual use or at Kinergy is always beneficial and sometimes it is required, many applications can be accomplished without it. Applying the appropriate calculations, combined with the years of experience, makes this possible. When this is done, all the details of the application need to be clearly and fully stated so the appropriate unit can be applied.

References

A "vibratory machine" is defined as any unit intentionally or purposely vibrated in order for it to perform useful work or some beneficial function.

Vibrating Screens are "Induced Conveying" units because they depend upon the generated vibratory action to move the material load. This factor differentiates them from the "Induced Vertical Flow" group of vibratory machines which all have the forces of gravity as the prime mover of the contained material.

To further qualify or substantiate this text, the following references are cited:

1. The "Vibrating Screen Handbook" as published by the Vibrating Screen Manufacturer's Association (VSMA) in 1980.

2. To apply these screening units, please refer to the technical presentation: "The Application of Kinergy Driven Vibrating Screens".

3. For a more detailed explanation of the Kinergy Drive System, please see Bulletin KDB-1, which also shows it applied to all the other "Induced Conveying" machines. Attention is called to the included chart which candidly compares the various kinds of vibratory drives available.

4. The "Variable Voltage" type of adjustable stroke and frequency controller for any Kinergy Driven unit is further described in Bulletin ES-KD-1 entitled "Electrical Control Characteristics and Schematics".

5. For the proper "interfacing" of feed boxes with surge hoppers when screening bulk solids, see Kinergy Bulletin IL-KDF.

6. For an explanation of how and when the various types of vibratory drive systems were developed and their respective characteristics, please refer to the technical paper entitled "The Evolution of the First 'Universal' Vibratory Drive System for Moving and Processing Bulk Solid Materials", 1964.


The intent of the text of this bulletin is to be professionally informative. Any suggestions or constructive criticism to improve it are invited. Please write:

George D. Dumbaugh, PE
Kinergy Corporation
7310 Grade Lane
Louisville, Kentucky 40219
Typical Applications

Kinergy Driven Circular or Unidirectional Vibrating Screens have been successfully applied to Flakes, Floodable, or General type bulk solid materials and to various "unit pieces". These industrial applications include the following:

**Aggregate Industry:** Primary, secondary, and tertiary screening of limestone or granite rock (Figure 34). The screening towers can be reduced in overall height. If pulverized limestone is made, it will need to be screened.

**Breweries:** Recovering spent grains and for separating "trash type solids" from their caustic solutions.

**Briquettes:** Cleaning the freshly made briquettes is the purpose.

**Cement Plants:** Removing unwanted fines from the clinker, and scalping the loaded cement, are some of the applications.

**Ceramic Product Manufacturers:** Removing impure particles from ceramic slip by Deliquefying Screens.

**Chemical Plants:** Most of the "Sizing" functions will be utilized here along with deliquefying units (Figure 35).

**Cool Preparation Plants:** After the incoming "Sizing" functions are achieved, Dewatering, Drain and Rinsing, are the typical Deliquefying functions that will follow (Figure 36). The cleaned coal may need to be "Sized" again.

**Food Processors:** Deliquefying screens for the canners of fruits and vegetables will be needed. Cereal manufacturers and meat producers have various screening needs. These units can be supplied with sanitary designs with the appropriate polished finishes when it is needed.

**Foundries:** The mold shakeouts (Figure 39), the cleaning of the shakeout sands, Attrition Mills, and Reclaimers are all needed.

**Composting Facilities:** Screening the decomposed municipal solid waste as shown in Figure 37.

**Detergent Manufacturers:** Scalping unwanted lumps from the detergent is the screen's purpose.

**Fertilizer Plants:** The "Size" screening of DAP, NPK, urea, or potash is the usual application (Figure 38). Most are "dust-tight".

**Grain Processing Plants:** The "cleaning" of the various grains which is usually done to USDA specifications (Figure 40). This includes wheat, barley, oats, soybeans, or the like. It is actually a "Grade Sizing" type of screening.

**Gold Ore Processing:** Deliquefying for the so-called "Trash", "Carbon" or "Safety" screen functions (Figure 41).

**Fig. 34:** Washing and "Grade Sizing" crushed rock in an Aggregate Plant.

**Fig. 35:** The "grade sizing of spent chemical catalysts" with the unit mounted on a truck trailer.

**Fig. 36:** One unit washing with water sprays and "grade sizing" coal in a small Preparation Plant.

**Fig. 37:** Two deck screening of decomposed MSW in a "composting" facility.

**Fig. 38:** The screening of DAP, NPK, urea, or potash for the processing of fertilizers.

**Fig. 39:** "Shaking out" this casting from the surrounding mold sand in a Foundry.

**Fig. 40:** The "Grain Cleaning" of wheat (shown), barley, oats, soybeans, and the like.

**Fig. 41:** Deliquefying gold ore slurry on either "Trash", "Carbon", or "Safety" Screens.
Mineral Beneficiation Facilities: Anytime a mineral is being cleaned, the various types of Sizing and Deliquefying Screens will be needed.

Pelletizing: Removing unwanted oversize and fines from the manufactured pellets will be the purpose.

Pharmaceutical: Screening powders and pellets, and removing fines from tablets or capsules. Polished finishes and sanitary designs will be required.

Material Recovery Facilities: Separating the glass and grit from "commingled" containers, which are usually plastic bottles or aluminum cans, is a typical application in a Recycling Facility (Figure 42).

Fig. 42: Separating the glass and grit from "commingled" containers in recycling facilities.

Sand and Gravel Plants: Grade sizing the silica sand.

Seed Suppliers: The cleaning of salable "seeds" will be needed.

Refuse Derived Fuels (RDF): Removing the glass and grit from the fuel to improve its BTU content and to reduce the amount of ash. Some air classification will probably be required.

Waste Water: Deliquefying screens are used to "clean up" the waste water of many facilities varying from Commercial Laundries to Pulp and Paper plants.

Wood Handling: Screening wood chips, bark, shavings, sawdust, or the incoming waste wood to "pressed log" or "fiberboard" manufacturers (Figure 43).

Fig. 43: Screening the incoming "wood waste" to "Pressed Log" or "Fiberboard" manufacturers. Both the "overs" and the "unders" are removed.

Fig. 44: The "Grade Sizing" of recently mined coal prior to loading into rail cars for shipment.

Fig. 45: The dewatering of fiberglass solids from a slurry.

Fig. 46: Screening the incoming "wood chips" to a Bio-Mass Fired Cogeneration Plant.

Fig. 47: A 6 ft. wide x 16 ft. long four-deck Kinergy Driven Screen in service separating "wood waste" at 60 TPH. It consumes 2 HP.

Fig. 48: This 4 ft. wide x 10 ft. long screening unit is installed under a bin so it can also act as a Feeder. Minus 1" coal is separated while it feeds 150 TPH. The power needed is 2 HP.

Fig. 49: These 5 ft. wide x 14 ft. long Deliquefying units perform the "Trash" screening function in a Gold Ore Processing Plant. They require 2 HP.

Fig. 50: Not all screening media is flat. Sometimes it is "formed". In this instance, it has pockets to trap sand lumps.
Kinergy's Many Vibratory Machines

The most complete line of vibratory machines for "inducing" bulk solid materials to either Vertically Flow or Convey.

Induced Vertical Flow: The vibratory action supplements the forces of gravity.

Discharging: The objective is a uniform, symmetrical and concentric vertical flow pattern.

Binning Activator  Sanitary Finishes  Activated Bin  Container Activator  Bulk Bag Discharger  Screw Feeders Complete Discharging Units  Storage Pile Discharger  Rail Car Discharger

Densifying: Accomplishes "Inherent Densification" at the point of loading.

Table  5 ft. x 22 ft. Mold Compaction Table  Container  Vertical Face  Rail Car Densifier

Induced Conveying: The intentional vibration is the prime mover of the bulk solid or unit pieces.

For the first time in the history of "Induced Conveying" machines, all these different units of various functions are powered by the same type of drive which inherently includes a full range of adjustable output by a simple method of electrical control.

Smallest: 2 by 15 inches  Largest: 12 by 36 feet

Circular Feeder  Unidirectional Feeders  Dust Tight Trough

Dump Hopper  Primary Crusher Feeder  Sanitary Designs  Conveyor

Circular Conveyor  "Sizing" Screen  Polished Finishes  Drive on one end

Fluidized Bed/Transferring Heat  Spiral Elevator  Deliquifying  Mixer or Vacuum Dryer

Shakeout Feeder  Shakeout Table  Attrition Mill/Sand Reclaimer