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WHITE PAPER

Selecting the Right Vibratory Feeder for Industrial Applications

Key Features & Components Give Precise Control of Material Flow

Vibratory feeders have been used in the manufacturing industry for several decades to efficiently move fine and coarse materials which tend to pack, cake, smear, break apart or fluidize.

Because they can control material flow, vibratory feeders handle bulk materials across all industries, including pharmaceuticals, automotive, electronic, food and packaging. Additionally, these feeders advance materials like glass, foundry steel and plastics at construction and manufacturing facilities.

Feeders can range from small base mounted, pneumatic-powered models moving small quantities of dry bulk material to much larger electro-mechanical feeders that convey tons of material an hour. Users turn to vibratory feeders when they want to move delicate or sticky materials without damaging or liquefying them.

Vibratory feeders handle a wide assortment of materials including but not limited to: almonds, crushed limestone, shelled corn, powdered metal, metal billets, various pipe fittings, scrap brass and bronze, crushed and shredded automobiles, hot dross and much more. Because they emit precise vibrations, companies also use vibratory feeders to process small parts, like coins, washers or O-rings, as they move along a belt conveyor.

Other common applications of vibratory feeding include:

- Controlled flow of ingredients to mixing tanks
- Sprinkling toppings or coatings on food and dairy products
- Adding binders and carbons to foundry sand reprocessing systems

- Chemical additive feeding in the pulp and paper bleaching or chip handling processes
- Feeding metal parts to heat treating furnaces
- Feeding scrap or glass cullet to furnaces

Manufacturers like Cleveland Vibrator Company have upgraded and modified vibratory feeders and conveyors over the years to enhance their role in multiple processing applications. The latest equipment offers increased energy savings, more precise control over material flow, easier maintenance and a broader variety of options.

Virtually all vibratory equipment—regardless of type or size—is built with materials that can withstand the harsh environment of the manufacturing industry. Vibratory feeder trays can be made from stainless steel which is far less susceptible to corrosive materials. The internal motor's fully enclosed construction offers protection from environmental elements to ensure maximum uptime.

Vibratory feeders save users time and money on maintenance as well, because they have no moving parts, aside from the vibrating drive unit. This means they break down less frequently and vibratory feeder parts are easy to replace. Other advantages of vibratory feeders include: ergonomic design, adaptability and versatility, effectiveness and accuracy.

HOW TO SELECT THE PROPER VIBRATING FEEDER DESIGN

There are two basic designs available when selecting a vibrating feeder: electromagnetic and electromechanical. A third option—air-powered vibrating feeders—are basically an alternate to electromechanical feeders since they have the same simple brute force design concept—the vibratory drive is directly attached to the tray.

The following are the basic advantages and disadvantages to these three feeders:

Electromagnetic feeders provide variable intensity with typically fixed frequency of 3600 vibrations per minute (VPM). They only require single phase power, offer quick stopping and are ideal for cold weather. However, they are sensitive to line voltage fluctuations and temperature swings and are not suitable for hazardous areas. They also need constant tuning if there are rate or load changes.

These units work well with dry, free-flowing, pelletized or granulated material. They can control material flow from a few pounds to several tons per hours and can be custom designed to accommodate material flow from a few feet (with a single drive) to up to 20 feet (with multiple drives).

Electromechanical feeders are powered by twin rotary electric vibrators which provide a broader range of stroke/frequency combinations. Their flexibility is further enhanced with a variable frequency drive (VFD), which provides quick and easy adjustment without having to manually adjust the eccentric weights.

A VFD with dynamic braking or a starter with a dynamic brake will end the vibration faster to limit the erratic motion at shut down. This design provides the quietest operation and is less susceptible to head loads. These feeders work well in hazardous conditions when explosion proof vibrators are installed.

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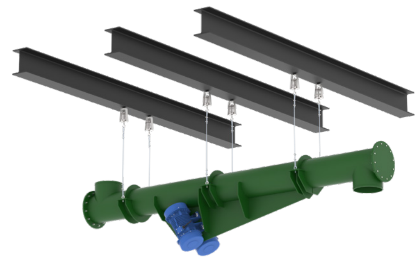
Air-powered feeders work best under hazardous conditions because they are driven by an air-cushioned piston vibrator, which produces smoother linear force and can work safely in high temperatures. It's the simplest of the three feeders to maintain and the controls are the most economical.



While an air-powered feeder doesn't require tuning, there are limitations to the physical size of the tray and feed rates. These units are also less suitable for outdoor operation because the air lines can freeze up. These feeders are also susceptible to head load.

TRAY DESIGNS ARE LIMITLESS

The shape, length and width of modern feeder trays are almost limitless. Customers can order custom feeder trays to suit their unique process applications. Every configuration of flat, curved, vee and tubular designs are available.

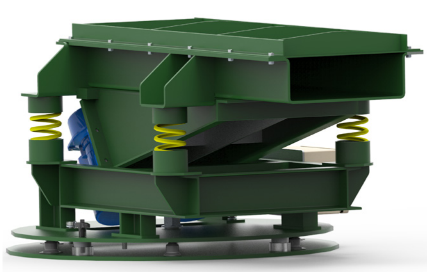
Units can be furnished with special coatings, such as non-stick polymer, non-stick textured surfaces or removable abrasive-resistant steel plate. Liners are available to protect the feed tray while processing harsh materials include neoprene, UHMW, and urethane. The trough can be furnished in steel or polished stainless steel to meet the most demanding requirements.

Trays can be designed for fast removal and cleanout to avoid cross contamination of materials and decreased production line downtime. Custom trays can have quick release clamps to enable removal of the tray and cover without tools. The tray is simply lifted and disconnected from the frame for easier cleaning.

SPRING SYSTEMS FROM STEEL TO FIBERGLASS

Springs are an integral part of the feeding system process because they convert the vibration from the drive to the tray, thus causing the material to move. Like trays, springs today come in a variety of materials, sizes and configurations depending upon the application.

Fiberglass springs are the most popular configuration for light and medium duty applications. Small electromagnetic feeders, light to medium duty conveyors and most high precision vibratory equipment use fiberglass or multiple pieces of fiberglass as their primary spring action material.



Steel coil springs are commonly used on heavy-duty and high temperature applications. These coils are effective in ambient temperatures up to 300° F.

Dense rubber springs are typically used on heavy-duty feeders and conveyors to provide stability and motion control between the drive and tray. However, rubber springs are limited to use in environments below 120° F.

Air mount springs are designed to handle tough industries such as construction and mining which present dirty, dusty and wet environments. They withstand common issues such as rust and corrosion that typically lead to broken parts. They also reduce structural noise and are versatile.

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FACTORS TO DETERMINE A VIBRATORY FEEDER

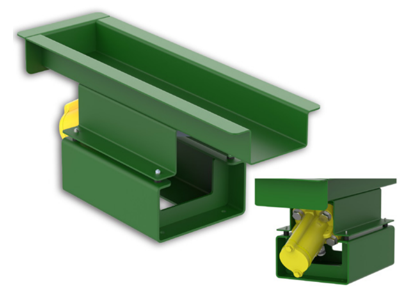
Typically, a feeder application will require the movement of some given material with a known bulk density over a desired distance. Parameters that influence the sizing and design of a vibratory feeder include:

1. The inlet and discharge conditions for that piece of equipment
2. How the material is being placed on the feeding surface
3. The dimensions of the incoming material stream
4. Batch dumping vs. continuous flow
5. Feeding another piece of equipment, such as a belt conveyor, bucket elevator or furnace
6. Feed rate
7. Material properties, including bulk density and particle or part size

The distance the material must travel drives the length of the unit and may include some additional length to properly interface with the receiving equipment. The volume of material moved per hour plus the materials' bulk density helps determine the width and depth of the vibratory tray. The size of equipment that passes material onto the vibratory feeder also factors into the feeder's width.

PROPER LOCATION OF VIBRATORS ON FEEDERS

There are several options when deciding where to install the vibrators on a particular feeder model. With vibratory feeders, there is a concern about the product discharge height, as the equipment is often feeding material downstream to other devices.



Typically on vibratory feeders the default location is "below deck" where the vibrators are attached on the underside of the unit. With below deck vibrators, the feeder will need a higher discharge height compared to a similarly-sized unit where the vibrators are "side mounted" or even in some applications where the vibrators are attached "above the deck."

Functionally, there is no benefit to locating the vibrators above, on the side or below the unit. Provided the structure is appropriately designed for the force output of the vibrators and they "sense" each other, either vibrator location can provide satisfactory results.

CONTROLLING MATERIAL FLOW FROM A FEEDER

Precise metering of material flow (whether moist or dry) onto trays or other receptacles is critical to the operation of any vibratory feeder, particularly those equipped with a hopper. Several factors below influence the material flow, but when all three are combined, it is possible to vary the flow rate and provide very repeatable results as the material cascades off the feeder end.

Bed depth of material on the tray. The material must be free flowing and always available in the hopper to charge the feeder. Not enough material will "starve" the feeder, reduce the bed depth and cause inconsistent discharge rates.

A hopper slide gate helps adjust material depth. Opening the gate allows for a higher volume of material to be removed from the hopper, resulting in a deeper material flow and higher volume off the feeder end. Likewise, reducing the opening restricts the volume of flow out of the hopper results in more shallow material flow as well as lower volume.

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Frequency of vibration applied to the feeder tray. Different materials respond better to different frequencies of vibration which influences the type of vibrator installed on the feeder.

For example, rotary electric vibrators are designed with various frequencies to accommodate different materials:

- Two-pole vibrators that operate at 3600 vibrations per minute (VPM) have the highest frequency and smallest amplitude
- Four-pole vibrators that operate at 1800 VPM
- Six-pole vibrators that operate at 1200 VPM
- Eight-pole vibrators that operate at 900 VPM

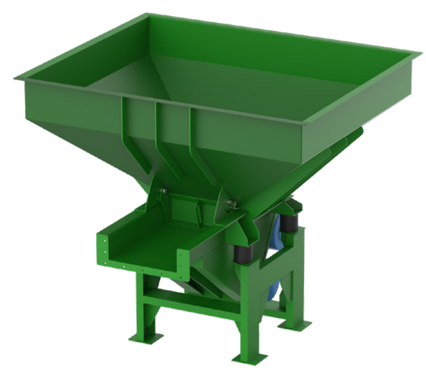
Heavier materials tend to require higher frequency drives while lighter materials feed more effectively with lower frequency drives.

Vibrators are installed based on the selected feed rate. This selection is based on the frequency of vibration and the maximum force output of the vibrator.

Necessary adjustments to the eccentric weights of the vibrators can be made to reduce the force output from the unit's rated maximum. For a given frequency, more force output will result in a larger amplitude or stroke of the finished equipment.

TECHNICAL SUPPORT IS KEY

Purchasing and installing a vibratory feeder poses fewer risks today because of increased technical assistance before and after the sale. Material samples of various densities and configurations can be tested beforehand to determine the optimum piece of vibratory and conveying equipment. This pre-testing virtually eliminates the potential problem of installing an under or oversized piece of equipment for the job at hand.



Cleveland Vibrator's in house testing lab includes an EMF Electromechanical Vibratory Feeder with independent variable frequency and manual amplitude adjustment controls. This allows CVC's engineers to determine optimal vibration conditions for any material and prediction of feed rates and process outcomes.

Customers can visit the facility or they can view the testing online in real-time or request a video of their product test.

Cleveland Vibrator provides ongoing support and training for its vibratory feeders. If you need assistance or have any questions about proper operation, contact Cleveland Vibrator at 800-221-3298.

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