ID-65
RESIDUE AVOIDANCE PROGRAM - FEED HANDLING SYSTEMS
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REVISED:
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Feed Handling Systems

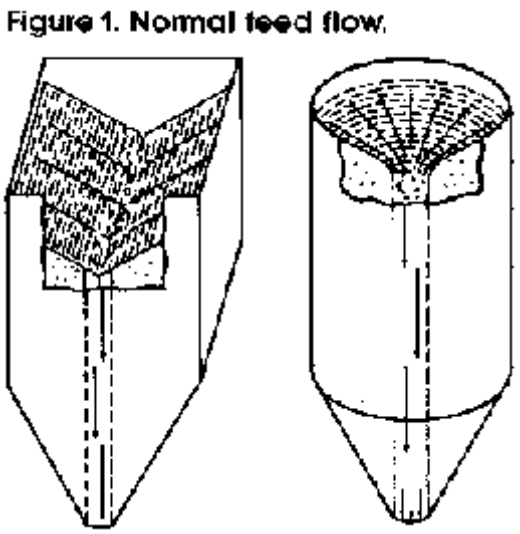


Figure 1. Normal feed flow.

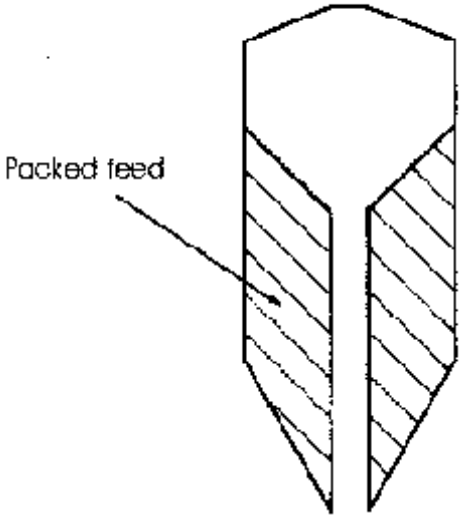
There are many combinations of equipment used to store, convey, and feed livestock feedstuffs. All of them include, as basic components, feed storage, feed conveyance, and feeders where feed is made accessible to the livestock. Each of these components represents an opportunity for the feed to become contaminated, possibly causing residues.

Drug carryover in feed products can occur in a number of ways. Feed manufacturing equipment such as mixers, pellet mills, conveying augers, elevator legs, dust control devices, and storage bins can contain dust and residual feed capable of contaminating clean feed that follows.

Feed Storage

The most common type of on-farm feed storage is the upright vertical bin. Most are metal but can be wooden, concrete, or of other materials. **Figure 1** shows the normal pattern of feed flow from an upright bin. Note that the material directly above the discharge opening is the first to leave the bin. Then, as a "vee" is formed, materials at the top cascade toward the low point move-out. The result is an emptying of the bin from the top down with some materials in the lower parts incorporated into the discharge flow. Thus, feed put into a bin first is not necessarily the first feed out.

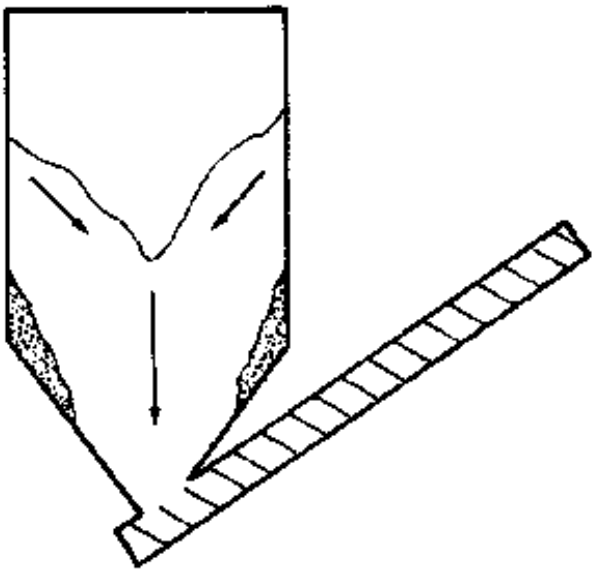
Figure 4. Extreme case of feed "hang-up."



Slope of the hopper bottom will affect this flow of feed. Figure 2 and figure 3 illustrate the minimum hopper slopes for whole grains and for most ground materials. Some feed materials resist lateral movement and can form a tunnel, which is called rat holing. An extreme example is shown in **figure 4**.

Feed hangup, such as rat holing, is a form of segregation and can be caused by several factors. These include feeds containing relatively high levels of molasses or added fat, or those that are moldy, coarsely ground, or abnormally moist. Feed hangup can be overcome by bin design [live bottom bin], by vibrators, by bursts from air jets, or direct agitation of the materials [poles, stirrers, etc.].

Figure 5. Feed flow in bulk bin.



Feed carryover can occur when feed attaches to the sidewalls [**figure 5**]. lf such bins are refilled before completely empty, feed in the dark areas will remain for a considerable length of time and possibly break off small quantities into the new feed stream. Because of this effect, such bins should be completely emptied and then visually inspected for residual feed whenever a change is made in kinds or amount of animal drugs used or to a nonmedicated feed. If residual feed contains animal drugs, potential for drug carryover exists.

A frequently overlooked, but simple measure to help reduce feed contamination is to identify each bin on a farmstead. Painting a number, feed name, or letter on the side of the bin near the filling door or ladder will serve to identify each bin and avoid confusion by feed delivery truck drivers, hired employees, and others.

Bin management techniques can greatly reduce carryover and improve feed quality. Periodically, all feed bins should be emptied completely and inspected. Feed not removed by normal means should be manually removed. This must be done when changing feed medications or switching to withdrawal feeds because it reduces the chance for mixing medicated and withdrawal feeds, and will also reduce buildup of moldy feed in bins. Moldy feeds are particularly a problem during hot, humid months and winter months when moisture condenses inside bins and runs down the sides onto feeds. Where several bins share a common wall, periodic inspection for holes that allow feed to flow between bins should be made. Similar inspections of augers that pass through bins may detect dumping of medicated feeds into withdrawal feed bins. Dusts from conveying medicated premixes and feeds into overhead bins may leave a layer of medication on unmedicated feeds.

Feed Conveyors

Screw augers are a common means of feed conveyance between storage facilities and to feeders.

Figure 6. Cross section of screw conveyor.

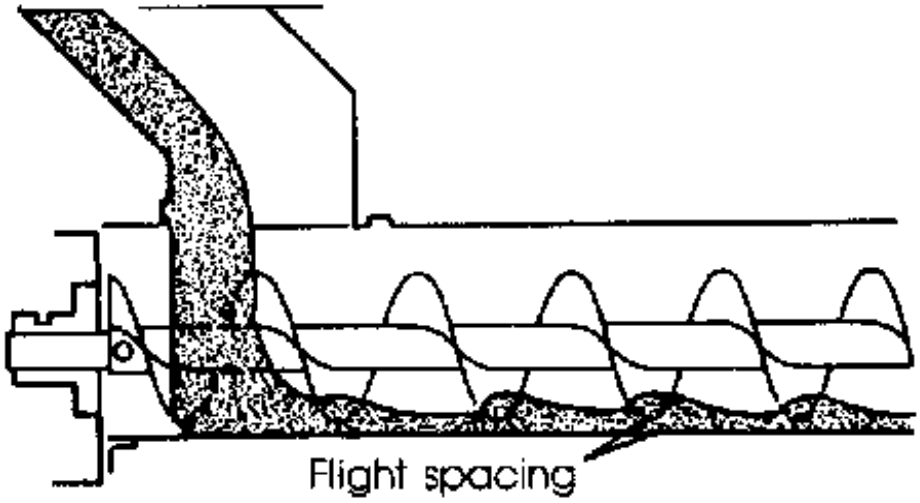


Figure 6 gives a cross section of a typical screw auger. Note the gap between the screw flights and the housing. This is necessary to prevent undue wear on the edges of the flights and on the auger housing. This gap allows a layer of feed to remain in the conveyor even though no more feed comes out the discharge end. This residual feed is usually removed when the next conveyance of feed is made. Depending on the length of the screw auger, considerable amounts of medicated feed can be carried over and discharged into the next bins or feeders that are filled.

Drag-type conveyors have much less residual feed carryover but are more expensive to purchase and maintain. The same precautions as for screw conveyors must be exercised.

Pneumatic Conveyor Systems

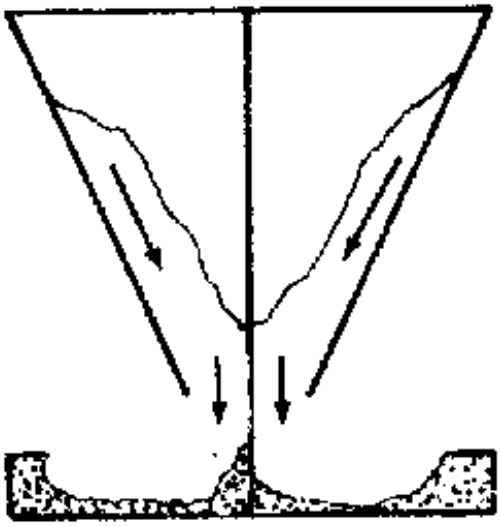
Pneumatic conveyance systems are increasing in popularity because of their capability to move large quantities of feed over extended distances. Segregation of ingredients can occur and, unless specific management techniques are implemented, residual feed left in the tubes may be a source of contamination of following feeds. Dust collectors [cyclones] may be needed in bins to ensure uniform feed distribution, Designation of which bins are being filled should be clearly visible at any coupling locations. This can help avoid a mistake in sending feed to the wrong location.

Any feed delivery systems may have low spots where feed can collect. For example, spaces between augers and diversion slides in feeder chutes will fill with feed as it passes over the chute. Therefore, it is recommended that withdrawal feeders be placed at the far end of auger runs or, better yet, on separate systems to avoid potential contamination. Levels of as little as 1 pound of medicated feed per 100 pounds of non-medicated feed may contribute to drug carryover, which may result in drug residues in animal tissues.

Feeders

Feeders come in a variety of shapes and sizes. Most provide a storage area from which the feed flows by gravity to the animal access area. Typical feeders are shown in figure 7 and **figure 8**. Note the feed

Figure 8. Feed flow in feeder.



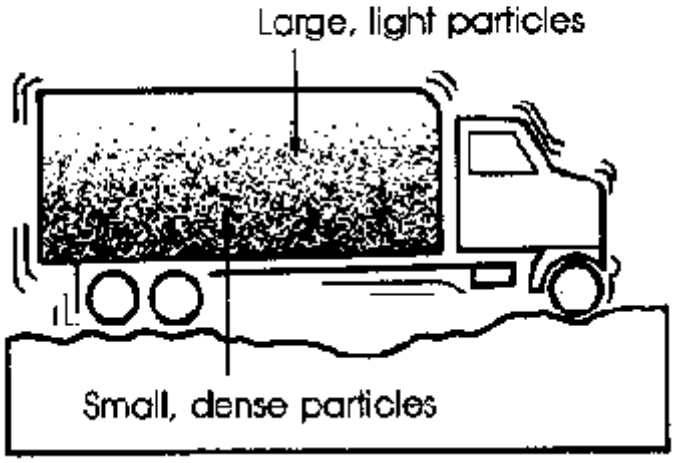
flow pattern and the areas where feed might continue to reside after the gravity flow ceases.

Depending on the shape of the feeder, considerable amounts of a medicated feed could remain ln a feeder that appears to be empty. Addition of new feed may dislodge part of the old feed, making it available to the livestock using the feeder. Because of this characteristic, feeders should be completely emptied, then visually inspected for residual feed whenever changes are made in kinds or levels of animal drugs or to nonmedicated feed.

Drop or floor feeding systems are less likely to cause contamination because residual feed is minimized. Feed allowed to build up in corners of pens due to overfeeding may be a potential source of residues.

What Is Segregation?

Figure 10. Segregation—rough roads.



Segregation can occur in ingredients and in mixed feeds. In ingredients, it is the separation of certain fractions or particles from the remainder of the material. ln mixed feeds, segregation is separation of one or more ingredients, or fraction of an ingredient, from the remainder of the mix. Segregation may occur at a number of sites ln the handling and processing operations used to manufacture and deliver feeds [figure 9 and **figure 10**]. Partial remixing may occur during handling and processing operations, reducing the overall segregation effect on the finished feed.

Mixed feeds are subject to segregation because of differences in particle size, particle shape, and density of the various ingredients. The feed ingredients, for example, can be satisfactorily mixed in the mixer, become slightly segregated as they drop into the bin, be somewhat

remixed in the bin auger and elevator leg, become markedly segregated in the free-air fail into the feeder, and be remixed (partially] in the outflow from the feeder.

Where Does Segregation Occur?

Table 1 lists some of the more common sites for segregation of mixed feed. Note that these are all subsequent to the mixing equipment. Theoretically, segregation can occur in mixers but the result is the same as incomplete mixing. Table 2 lists some possible solutions.

Table 1. Sources of segregation problems.

Location	Possible Problems
Mixer surge bin	Free fall from mixer segregates particles Air pressure relief segregates particles Mill or equipment vibration Electrostatic hang-up
Bucket elevator	Segregation of particles at elevator discharge
Pneumatic conveying	Segregation of cyclone collector Free fall from collector to bin Angle of repose of feed segregates particles by size
Holding bin, bagging bin	Segregation occurs as feed falls through air
Bulk bin, bulk truck, customer bin	Funneling during discharge accentuates segregation Vibrations of mill or equipment segregate particles Electrostatic hang-up
Dust collecting systems	Very fine particles tend to be aspirated off, particularly when air flow rates are high Returned dust is not thoroughly mixed back into feed

Table 2. Overcoming segregation tendencies of mixed feed.

Property	Remedy
Particle size	Grind ingredients to a uniform particle size range Use liquids to agglomerate
Particle shape	Process to more uniform particle shape range If shape is a desired characteristic, use fat or molasses to agglomerate
Particle density	Agglomeration is the most common way to overcome density differences Finer particle size reduces tendencies to segregate because of density differences

What Causes Segregation?

The major factors involved in segregation are particle size, shape, and density. Very large particles and very fine particles tend to segregate when combined. Particle shape is a definite factor both when particles are ln free fall through air and as they pile up ln storage. Flat particles will tend to fail slower

and remain where they fail. Round or near round particles will fall faster and will tend to roll towards the storage walls. Particles with high density will be less affected by the free fail air resistance than will those of low density. The less dense and smaller particles will tend to be carried toward the walls by the air currents created in the bin.

These factors interact in many ways. For example, a formula that combines large, flat, low-density particles with small, cuboidal, high density particles (such as a mix of rolled oats and salt] results in a mixture that segregates markedly when subjected to vibrations or dropped into a storage bin. Addition of other ingredients having physical properties between these extremes will greatly improve the stability [reduce the tendency to segregate] of the mixed feed. Additions of fats, molasses, or other liquids also will reduce particle segregation by agglomerating smaller particles into larger ones.

Electrostatic charge buildup in mixing equipment may cause small particles to attach to the mixer or metal handling equipment. Some drug compounds are more susceptible to this phenomenon than others. Enough drug may become attached during production of medicated feeds to produce residue in subsequent batches. Electrical grounding of mixing and delivery equipment will minimize this carryover. Selection of drug premixes with larger particle sizes will reduce electrostatic carry over potential.