Quality assurance programs in feed manufacturing

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FEED manufacturers should begin to evaluate their current quality program and determine what revisions may be necessary to address the changes in the U.S. feed regulations over the next year. The Food & Drug Administration Food Safety Modernization Act (FSMA) that was signed into law by President Obama on Jan. 4, 2011, will create a shift in how federal regulators approach the feed manufacturing process. The aim of FSMA is to ensure that the U.S. food supply is safe by shifting the focus of federal regulators from responding to contamination to preventing it (FDA, 2011).

FDA was given 18 months to develop new regulations that focus on ensuring a safe food supply through preventative measures. Although the final rules may not be in place for several months, feed mills should begin reviewing their current quality programs. The new regulations state: "The owner, operator, or agent in charge of a facility shall, in accordance with this section, evaluate the hazards that could affect food manufactured, processed, packed, or held by such facility, identify and implement preventive controls to significantly minimize or prevent the occurrence of such hazards and provide assurances that such food is not adulterated under section 402 or misbranded under section 403(w), monitor the performance of those controls, and maintain records of this monitoring as a matter of routine practice" (FDA, 2011).

These new regulations will require feed manufacturers to conduct a hazard analysis of their processes, as well as to develop and implement a written preventive control plan that includes monitoring, verification, corrective actions and recordkeeping (Epperson, 2011).

The requirements of the new regulations should be integrated into the feed mill's written quality plan. Feed mills should have in place a comprehensive feed quality assurance (QA) program to manage the materials (ingredients and supplies), equipment, personnel and procedures to efficiently deliver safe feeds that consistently contain the formulated nutrients to optimize the production of meat, milk and eggs. When developing a quality program it is important to understand that QA is a comprehensive program of controls directed at ensuring the production of feeds that meet a predefined set of standards (Rydell, 2005; Boyd, 1993). QA refers to the policies, procedures and process controls that yield a consistent product, whereas quality controls (QC) are the in-plant process measurements that insure quality parameters are met during receiving, manufacturing and delivery.

Development of quality assurance programs

A comprehensive QA program will include employee training, ingredient specifications and traceability, QA manual, standard operating procedures, critical control points, sampling and analytical schedules, reporting systems and review processes. A company's business model should define the goals and objectives that must be met to either maximize sales or optimize the production of meat, milk or eggs. In addition to meeting the goals of the company's business model, the QA program must also ensure the production of safe feed. Certification programs such as Safe Feed Safe Food (SFSF) offered by the American Feed Industry Assn. (AFIA) requires feed mills to develop QA teams, create mission statements and set quality goals as part of the certification process (Stark, 2010). The development of a QA manual is an essential component of a quality program. The National Grain & Feed Assn. (NGFA) model "Feed Quality Assurance Program" (NGFA, 2005) contains six components that should be included in a QA manual:

(1) Purchasing and receiving;
(2) Feed manufacturing and process control;
(3) Finished feed sampling, inspection and labeling;
(4) Feed shipment and delivery;
(5) Sanitation and pest/rodent control, and
(6) Feed product investigations/recalls.

Since the development of an actual QA program, control policies and procedures must be adapted to the needs of each facility, this article will focus on the basics of a feed QA program and quality control measures rather than on specifics in the hope that the discussion will stimulate thinking and innovation in the field of feed-quality assurance and controls.

Ingredient purchasing, receiving

The percentage of by-products from bio-fuels in formulas has increased significantly over the last several years, feed manufacturers often find themselves managing the variation of these by-products in an attempt to convert low-quality, inconsistent ingredients into a consistent feed that meets the nutrient requirements of animals. Feed mills do not have a magical formula for improving poor-quality ingredients, but through the use of ingredient segregation, grinding equipment, long-term conditioning and pelleting, the nutrient utilization of ingredients can be improved. However tempting it may be to purchase low-cost, inconsistent-quality ingredients, feed mills typically are not designed to manage ingredient variation and often do not successfully manage the variation. The result of not managing the variation is an inconsistent feed both in terms of nutrient content and physical appearance. In today's competitive business environment, product variation will lead to a loss of customers and variation in animal performance.

Ingredients can account for 70-90% of the cost of producing feeds (Jones, 1989). Furthermore, as feed mills get larger, the percentage of the total cost accounted for by ingredients will tend to rise. Not only does it make good economic sense to pay attention to ingredient quality, but a large portion of the variation in the nutrient content of finished feeds can be traced to ingredients. In fact, one poultry company was able to associate ingredients with 40-70% of the variation in nutrient content of the finished feeds (Jones, 1989). Nutrient content variations violate the primary objective of feed manufacturing and cost in terms of performance.

Ingredient quality has been defined by various individuals as "fitness for use" or "meeting an expectation" or "degree of excellence" or "conforming to a standard." Although near infrared spectrophotometry (NIRS) is used by a number of manufacturers to rapidly determine the moisture, fat, protein and fiber content of an ingredient sample, many feed manufacturers do not analyze ingredients prior to use. Feed mills that do analyze prior to receiving as discussed earlier may not have the ability to segregate and re-formulate based on receipts, especially in large plants that turn their inventory several times a week. Hence, most manufacturers operate on "supplier/plant histories." Therefore, predictability is important with respect to feed ingredients. Ingredients must be predictable not only in their nutrient content but their physical prop-

erties. Said another way, high-quality ingredients meet expectations not just some of the time but most of the time.

It should be obvious from the preceding discussion that the first priority in the production of quality feed is to understand and define ingredient quality in specific terms. This means that ingredients must be described in two ways. First, they must be described in terms of analytical values (moisture, protein, fat, etc.), and second, they must be described in terms of physical and/or sensory characteristics (density, color, odor, etc.). The first depiction describes ingredients in terms that analytical chemists understand, while the second describes ingredients so that the feed mill personnel can make decisions about ingredient quality.

AFIA publishes a book titled "Feed Ingredient Guides II" that describes the color, odor, texture and test weight of feed ingredients as well as typical nutrient levels. Receiving personnel should have ingredient reference samples, which include examples of both desirable ingredients and undesirable ingredients.

Ingredient-quality programs that stop with physical or sensory definitions of quality generally do not consistently obtain quality ingredients. More objective means of determining quality must be used as the ultimate judgment of ingredient quality. This objective determination is accomplished by laboratory testing and analysis. While method description is not the objective of this article, it is important to be reasonably certain that laboratory results are reliable. Due to the fact that several methods exist for measuring a nutrient, it is important to specify the analytical method in the ingredient specification sheets, as results may differ based on the method (AFIA, 2007).

In the U.S., two organizations publish manuals that contain methods approved for the analysis of feeds: the Association of Official Analytical Chemists (AOAC) and the American Oil Chemist's Society (AOCS). Analytical results from laboratories employing methods that have not been approved by AOAC, AOCS or similar organizations can be highly questionable. Both organizations also conduct check sample programs, as well as the Association of American Feed Control Officials (AAFCO). Check sample programs provide participating laboratories with identical feed samples for analysis. Results are then analyzed and used as a basis to provide laboratories with an evaluation of both the accuracy and the precision of their analytical work. Check sample programs are crucial in verifying the accuracy of results. In fact, results from laboratories that are not participating in a check sample program can be challenged in disputed situations.

In a very real sense, the ingredient quality received by a given feed manufacturer begins with your suppliers. Ingredient quality received at a given facility may well be a reflection of what your suppliers believe you want in terms of quality. Consequently, the first task in a good feed quality assurance program is to design an approach to communicate your dedication to quality to ingredient suppliers.

While there can be a myriad of approaches, the following steps outline one approach to communicating your commitment to quality to employees and suppliers:

(1) Commitment to quality begins with you. If you are committed to obtaining quality ingredients, your behavior must reflect that commitment, otherwise your suppliers will see through your lip service and supply the ingredient quality your actions have indicated you want. This means that companies MUST NOT just look for bargains (low price) in feed ingredients, that quality must be foremost.

(2) Decide what you want in ingredients and put it in writing. Include the following in your specifications: visual appearance of the product, physical characteristics (e.g., grind or bulk density) of the product, expected analytical assay values, sampling procedures, analytical assay methods, criteria for refusing to accept ingredient shipments and the process for deficiency claims. Discuss these specifications with your suppliers to determine whether or not they can supply your needs. Companies should have an approved supplier list of those companies that meet your quality needs. The approved supplier list and ingredient specifications should be sent to the receiving personnel, the laboratory manager and purchasing agent.

(3) Examine all incoming ingredients thoroughly. It is particularly important at this point to be certain that samples of the load are collected correctly. Following sample collection, appropriate on-site quality-control tests (e.g., moisture, test weights, mycotoxins, rancidity, etc.) should be performed. If the load is found deficient, it is important to reject the load. While rejection of deficient loads may seem to be a drastic step, it is a step that will leave no doubt in your supplier's mind as to your commitment to quality. A company should have a written rejection process that outlines the steps for rejection, which includes documentation of all the pertinent information, a sample of the rejected product and pictures as necessary.

(4) Have ingredient samples analyzed by a qualified laboratory. The values obtained from these analyses will provide you with a continuing evaluation of the quality of your supplier's product. This step is also necessary since laboratory results are necessary to provide the ultimate judgment of ingredient quality.

(5) QA groups should develop meaningful reports. Feed mill managers, nutritionists and purchasing agents must have reports that allow them to make timely management decisions to improve ingredient quality. Generating analytical results that are not used in management or purchasing decisions due to a poorly designed report is both a waste of time and resources in a company. Graphs can be used to illustrate quality over a period of time and can include upper and lower control limits. Summary tables, on the other hand, should focus on a few important numbers such as the average, standard deviation and number of samples.

(6) Communicate often with your suppliers about quality. Let your suppliers know that you are aware of the quality of their product. This will help your suppliers know that you really care about receiving high-quality ingredients.

(7) Adjust your formulas to reflect the assays you are receiving. If you do not adjust your formulas to reflect the actual assays, in effect, you have wasted much of the time and money you spent on the assays.

In terms of feed ingredient quality, this means that variations in the nutrient content of finished feeds may be associated with the number of suppliers and that each supplier is an additional source of variation. These variations lower quality and raise costs. Thus, obtaining ingredients from a single supplier who cares about quality may make economic sense.

Process control

The process by which high-quality ingredients are made into

Guidelines for evaluating variation in mixing time

CV	Rating	Corrective action
< 10%	Excellent	None
10-15%	Good	Increase mixing time by 25-30%
15-20%	Fair	Increase mixing time by 50%, look for worn equipment, overfilling or sequence of ingredient addition
20%+	Poor	Possible combination of all the above. Consult extension personnel or feed equipment manufacturer

high-quality feeds involves three components within the feed mill: personnel, equipment and procedures. If quality is lacking in any of these three components, the consistent production of high-quality, safe feed is unlikely. However, it is equally important to ensure that personnel, equipment and procedures are "blended" together toward the goal of efficient production of high-quality safe feed.

Personnel. Three general characteristics should be sought in new mill employees: productivity, interest or alertness and the ability to work as a team member.

Once hired, employees should complete a formal training process that outlines their responsibilities in manufacturing a safe, quality feed (Stark, 2009). This training should include not only what job to do, but why the job is necessary. Employees should be informed initially and reminded periodically through the performance review process how important their job is to the total quality effort and how their performance compares to that of their job description. Training documentation is also required by government agencies and is a component of third-party certification programs. Once trained, the company saves money if employees are encouraged to stay with the company. This means employees must be motivated, either by the work or by the manager to remain on the job.

Company commitment to quality must be supported by everyone from top management down. Employees who do not follow the company policy on quality will undermine the program. Managers who accept ingredients that do not meet company specifications send a message to their employees that quality standards are not important.

Equipment. Equipment selection, operation, repair and troubleshooting can become a very complicated matter, which can not be covered adequately in a short space. However, applying the following general points to each specific piece of equipment will help reduce equipment problems:

- Application: Was the equipment designed to do the job it is doing?
- Installation: Was the equipment installed according to the manufacturer's recommendations?
- Adjustment: Are the critical adjustment points within the machine set correctly?
- Operation: Is the machine being operated according to the manufacturer's recommendations?
- Capacity: Is the equipment being run within the rated capacity?
- Lubrication: Is the correct amount and type of lubricant used within the time frame suggested by the manufacturer?
- Maintenance: Does your company have a written preventive maintenance program? Can you predict when maintenance and possible repairs will be needed on each piece of equipment? Do you have spare parts and tools to perform maintenance and repairs?

Procedures. Procedural difficulties are common problems in feed mill operations. Feed mills either don't have written standard operating procedures (SOPs), haven't trained their employees to the SOPs or don't follow them as written. SOPs should be developed for each critical operation in the feed manufacturing process. They should be included in new employee training and the operator certification process. Every procedure instituted should incorporate the following:

- Communication: Does the person doing the procedure understand what is expected? If another person had to take over their job would he/she understand?
- Identification: Are controls on equipment clearly identified? Are bagged ingredients clearly labeled and stored in an orderly manner?
- Traceability: Will this procedure allow you to trace problems to their source?
- Verification: Are samples being taken and stored that will allow you to verify the source of the problem?
- Records: Are all records being kept of use? If records are of no use or potential use discontinue collection. Useful records should be stored in a clean, safe and accessible place.
- Safety: Does the SOP outline the safety procedures (lockout/tag-out, permits, etc.) and the appropriate personnel protective equipment (PPE) required to properly complete the operation?

Finished feed

In many situations, feeds are used rapidly after they are manufactured and animals consume the feeds before any assays can be performed. However, finished-feed assays are necessary and important because they provide the mill with a "final report card" on how well quality was controlled.

How much finished-feed sampling and analysis should be done? While the answer to that question will depend on numerous factors, a general rule of thumb is to collect two samples of each formula per week or one per batch run. Integrated operations should develop a sampling program that obtains one or two feed samples on each shift in order to monitor the manufacturing process throughout the week. Commercial operations should collect a sample of each batch run in the event that there is a customer complaint.

Labeling feed correctly and the final review of the feed labels is typically the responsibility of the QA group. AAFCO has established labeling guidelines as part of its model feed bill, which has been adopted by a number of the states. Labeling requirements may vary from state to state; therefore, it is important to be familiar with the requirements of the state(s) in which you manufacture and sell feed. The AAFCO label format can be found at its web site at www.aafco.org.

Feed shipment, delivery

Feed shipment and delivery is the last step in the manufacturing process. Written programs should outline the steps the delivery driver must take prior to loading the truck, during the loading processes and, finally, how the feed is delivered at the farm. The procedures should outline sequencing and flushing steps at the farm or upon arrival at the feed mill. In addition to the delivery process, there must be adequate documentation to trace the product from the feed mill to the delivery location. This information is required in the event of a product recall. The information is also required for companies that must adhere to the rules established in the Food & Drug Administration's bioterrorism act of 2002. Finally, delivery trucks and trailers should be inspected as part of a routine preventive maintenance program. The inspection should look for material build-up in transfer points, broken gates, cracks in the compartments and worn transfer equipment (screw and drag conveyors).

Sanitation, pest/rodent control

Sanitation and housekeeping programs help maintain a safe and clean working environment for the mill employees and make a good first impression on customers and inspectors. A well designed and executed housekeeping program also helps control pests (insects, mice, rats and birds) by eliminating their food and water sources and nesting areas. Clean feed mills are a result of the commitment of the management, operators and maintenance group. The manager must set the housekeeping standards and expectations and then lead by example, operators must maintain a clean work area and report problems to management and maintenance employees must seal all conveyors and ensure the dust control equipment is functioning properly.

Feed product investigations/recalls

A written program should be developed to handle custom-

er complaints, feed investigations and recalls. Customer complaints should be investigated immediately using a checklist that outlines the investigation steps and documents the findings and corrective actions of the complaint. In the event that an investigation results in a recall, there should be a process in place that identifies the recall team members and their responsibilities. Recall team members typically include individuals from feed manufacturing, quality assurance, sales, management, legal or regulatory and public relations. The feed recall plan should be reviewed annually and a mock recall conducted at least once every two years to evaluate the effectiveness of the recall plan, process and team.

Feed mill quality, process control

Feed mills should use a systematic process for identifying, monitoring and controlling possible sources of microbiological, chemical and physical hazards, starting with raw materials and ending with product consumption (Fairfield, 2009). A preventive control plan should be developed and implemented for hazards identified within the manufacturing process. The written plan should include monitoring, corrective actions, verification and recordkeeping that minimizes or prevents the occurrence of the hazards. The establishment of "quality control" (QC) points throughout the manufacturing process can be an effective tool in the prevention of hazards. The feed mill's comprehensive QA program should establish QC points for personnel, equipment and procedures. Control can best be maintained by applying effort at the QC points in the mill. The following QC points should be considered:

(1) Ingredient inventories. Ingredient inventories can be frustrating to mill personnel. However, since inventory programs provide manufacturers with a measure of checking to see that the correct amount of ingredient has been used in a given time period, these programs can allow manufacturers to identify errors in the process. McEllhiney (1981) pointed out that good ingredient inventory systems meet the following criteria:

- They are simple and understood by all;
- They include physical inventories;
- They are accurate;
- They consider history and forecasts, and
- They are used.

Whether the system is simple or complex, all inventories, except those for drugs, should be done at least weekly, preferable daily by the same person. Registered feed mills must complete a drug inventory each day by law. Theoretical and actual use of ingredients should be reconciled. In this reconciliation, Andrews (1991b) pointed out that the following tolerances are acceptable based on the amount of product used: less than 100 lb., 4% variation; between 100 and 4,000 lb., 2%, and more than 4,000 lb., 1%.

(2) Bin cleaning. If bins are not periodically cleaned, ingredients or feeds can build up on the sides, encouraging mold growth and cross contamination. Thus, finished feed and ingredient storage bins should be inspected at least once each month and cleaned as needed. While such cleaning is important, employee safety is even more vital. The feed mill must have a written confined space program, which identifies both the confined spaces and permit-required spaces. Employers that require employees to enter confined spaces must provide the proper bin entry equipment and training for each individual involved in the procedure. Written model programs and training material are available through NGFA, the Grain Elevator & Processing Society (GEAPS) and AFIA.

(3) Inspection of equipment cleanliness and condition. While a feed mill's preventive maintenance program should ensure that equipment is periodically examined, certain critical points and equipment should be examined more frequently. Discharge gates and elevator boots should be cleaned and inspected for wear or leakage. Elevator head pulleys should be checked for proper belt alignment and lagging, heat and wear. Distributors should be examined for correct position and wear. Finally, scalpers or ingredient cleaning equipment should be checked for proper operation.

(4) Grinding. If the hammermill and/or other grinding equipment do not operate correctly, then mixing, pelleting and animal performance may suffer. Thus, hammer and screen condition and wear should be checked routinely. Magnets should be cleaned and checked for correct operation daily or at the shift change. Grind consistency should be checked visually each shift to ensure that there are no holes in the screens. The particle size of the ground material should be checked weekly using the standard particle analysis method (ANSI/ASAE S319.3 FEB03) and compared to the company target. The particle size of grain used in pelleted feeds should be less than 600 microns. The grain in mash feeds should be in the range of 700—900 microns to reduce flowablility problems in feed storage tanks.

Hammermills are typically selected in operations that produce pellets due to their ability to produce a consistent fine-ground product, easy operation and minimal maintenance requirement. Roller mills are often selected in feed mills that primarily produce mash feed. Roller mills will produce a granular product that has better flow characteristics than hammermill-ground material.

Special attention should also be paid to the removal of heat from ground grains exiting the hammermill, especially if the mill is targeting a grind of less than 400 microns. If ground grains are not cool, the heat can cause moisture migration leading to excessive mold growth. In addition, excessive moisture or heat can cause ground-grain tanks to deteriorate more rapidly than normal. Air-assisted grinding systems can reduce the heat associated with grinding, reduce hammer wear, and increase throughput.

(5) Batch system validation. Batch system validation should be done on a monthly basis. Begin the validation process by verifying that a clean finished-feed bin is available. Next, batch and mix a mash formula in the usual manner and record the batch weight. Convey the batch to the clean finished-feed bin, load it out into a bulk truck and record the truck weight. Batch weights and truck weights should be within 1% of each other. If weight differences are more than 1%, begin by checking the following in the batching system:

- Batch and micro-scale accuracy;
- Bin integrity (Is there a hole in the bin wall?);
- Turnhead position and maintenance (Does some feed get diverted to another bin?), and
- Mixer and batch scale slide gate operation (Does one batch leak into another?).

(6) Mixing. Mixing is one of the most critical steps within any feed manufacturing operation. Batch mixers should be examined routinely as part of the preventive maintenance plan. Inspect the mixer shafts, ribbon paddles or screws for build up — excess build up is typically associated with incorrect liquid application and/or nozzle placement in the mixer. Mixing times should be checked at least twice each year.

Sometimes premix manufacturers will check mixer times as a service to their customers. However, no matter who checks the mixer's uniformity, mixing time should be correctly evaluated. Procedures for checking mixing time are outlined in Feed Manufacturing Technology V (which can be purchased through AFIA) and the Feed Additive Compendium (Jones, 2010). While a coefficient of variation (CV) of 10% or less is generally accepted as a homogenous mix, the guidelines shown in the Table can be used when evaluating CV results. The most common problems are insufficient mix time, operation of the equipment beyond its design capacity, and broken equipment or worn rib-

bons (Wicker and Poole, 1991). Wicker and Poole (1991) also pointed out that CVs of 4-7% are attainable in production situations when synthetic amino acids are used as a marker in the feed.

(7) Pelleting and cooling. Pelleting and pellet cooling is a complex process that has a number of input variables that must be routinely monitored and adjusted. Particle size, mash moisture, steam quality and air temperature and humidity will affect the quality of the finished feed. While automation systems have made the process simpler and more accurate, the following indicators of quality should be examined on a regular basis:

• Conditioning temperature. Conditioning is probably the most important part of the pelleting process (Andrews, 1991a). When feeds are adequately steam conditioned, pellet durability is improved. In addition, the heat of conditioning is important in the activation of mold inhibitors (Tabib et al., 1984) and reduced the incidence of pathogens such as salmonella (Blankenship et al., 1984).

Conditioning temperature should be as hot as possible (preferably greater than 180°F in the winter and 190°F in the summer). Steam provides both heat and moisture to soften the ingredient particles and activate the natural binding characteristics of the proteins and starches within the ingredients. The moisture content of feed should be 17-18% after conditioning. However, attention should also be paid to heat-sensitive feed additives such as enzymes and vitamin levels. Fat-soluble vitamin activity can be destroyed by the pelleting process (Jones, 1986).

• Cool-pellet temperature. The temperature of adequately cooled pellets (or crumbles) should be within 5°F of ambient temperature. Cooling problems are generally associated with bed depths that are too high or low, incorrect air balance (volume and velocity) and uneven bed depth. When pellets are inadequately cooled, moisture migration, mold growth and bin corrosion problems are likely to occur. Cool-pellet temperatures should be checked once each shift.

• Moisture gain. Moisture gain from pelleting is checked by comparing the moisture of the mash prior to pelleting with the moisture of the cooled pellets. Moisture gain can accelerate mold spoilage problems. While no moisture gain is a worthy goal, a more attainable goal is less than 0.5%. Removing the moisture in the feed is more difficult during the colder months of the year when the air has a lower moisture-holding capacity. Moisture gain should be checked weekly.

• Crumble texture. The texture of crumble feeds should be closely controlled, since incorrect crumble size can lead to palatability problems and inefficient animal production. Yet there are difficulties sometimes in determining the correct crumble size. While rules of thumb are dangerous, field experience suggests that about 50% of correctly sized crumbled feeds will be retained on a U.S. #12 sieve.

• Pellet durability. Many of the benefits of pelleting on animal growth and feed conversion are due to the physical form of the feed. Thus, durable pellets have a positive effect on animal performance (McKinney and Teeter, 2004; Stark, 1994). The two primary methods for testing durability are the Kansas State University tumbling box and Holmen tester. Both methods can be used to model pellet handling in the feed manufacturing and delivery process. The Kansas State procedure is an ASAE standard method (ASAE S269.4), which is described in Feed Manufacturing TechnologyV (may be purchased through AFIA).

However, it is important to understand that the pellet durability procedure has a certain amount of inherent variation that must be taken into account when interpreting results. Pellet durability tests are a useful tool to predict the amount of fines in the field. Consequently, each method should be modified to produce results that predict the amount of fines that will be delivered to the customer and, ultimately, to the animal. At least four samples of a given feed should be tested throughout the pelleting run in order to determine the average durability. Durability should be checked at least once each week, preferably daily.

(8) Meters and scales. If the mixing process is under control, whether or not the formula is made according to the nutritionist's recommendation may well depend on the accuracy and adjustment of the scales and meters. Thus, each facility should own and use test weights to check the calibration of scales weekly. Batch scales should be cleaned and inspected at least once each month, while micro-ingredient scales should be cleaned and checked weekly. All scales should be professionally serviced at least twice each year, preferably quarterly. Liquid metering devices should be checked and adjusted at least quarterly. Post-pellet liquid application equipment and metering devices should also be checked periodically during long formula runs.

(9) Truck inspection and cleaning. Trucks are sometimes overlooked as a source of moisture, mold and drug contamination. Companies should have flushing and sequencing procedures in place to prevent cross-contamination of medicated feeds. Truck drivers should be held responsible for the soundness and cleanliness of their trucks (both inside and outside). However, it is important that mill personnel also ensure that trucks are clean and in good repair prior to loading.

The production of safe feed for animals is the responsibility of all employees at the feed mill. Employees must understand the importance of their job in the production of safe feed and this must be reinforced by the management within the feed mill. The production of high quality safe feed is a team effort, which requires the commitment of top management, the feed mill manager, and production employees.

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