Designing Efficient Feed Centers

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Abstract/Summary

Feed centers are a critical component of the dairy design. Feed cost often represents more than 50% of the total cost of milk production. Designing feed centers, which reduce feed shrink and improve the overall efficiency of feed delivery are an important consideration in dairy design. As dairy farms increase in size, greater opportunities exist to design efficient feed centers that service thousands of cattle. The greater the number of cattle served, the greater the opportunity to take advantage of design improvements and the application of technology. Automation of the feed center is advancing rapidly. Feed centers need to be able to receive ingredients and simultaneously mix and deliver rations to cattle. Keeping the flow of equipment and personnel safe and efficient are dependent on efficient designs. In addition, new centers should include equipment of the appropriate size and capabilities to improve the efficiency of mixing and diet delivery.

Introduction

Feed center design continues to change to meet the challenges of increasing the overall efficiency of the dairy. Feed costs generally account for more than 50% of the total cost of production and even small savings help increase the potential profit margin of the dairy. Extreme feed costs in 2022 have increased the discussions around feed centers. Increasing cost of fossil fuels has generated a lot of discussion about utilizing electric motors to replace gas and diesel engines. Designing an efficient feeding center requires careful planning that includes consideration of the current situation and goals, site and existing facilities, future facilities, traffic patterns, equipment, technology, shrink, safety, loading efficiency, and delivery efficiency.

Current Situation and Goals

First in the planning phase, a dairy farmer should do a deep dive on the current situation. If you can't measure it, you can't manage it. The team really needs to build a good data set to determine the current situation and then work on the major goals for the new feed center. Feed shrink is an important consideration. For each of the ingredients handled on the dairy, what is the current feed shrink? This varies widely based on environment, current structures, storage time, and overall management of the facility. Today's feeding software allows for the tracking of shrink. Baseline shrink data may have some minor errors but will provide data for the setting of goals for the new facility.

Next, look at the issues of labor, time, and fuel for the current facility. How long does it take to load and mix a load of feed? Determine the number of cows fed per hour. Conduct a time and motion study to determine how long

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it takes to add individual ingredients to the mixer. This provides accurate data to determine opportunities to decrease loading time. How much fuel is required per load of feed? This includes all the equipment needed to load, mix, and deliver a load of feed. Make sure to include idle time. It is amazing how many hours of time are associated with idling equipment. Your equipment dealer might be able to help. Some of the newer tracking systems allow for a breakdown of hours of operation at different engine speeds. This provides great insight into equipment operation. With the current data assembled, it is time to move forward to the goals of the new feed center.

Goals for the new feed center are important. Based on the current situation, what are the opportunities? Make sure to consider the economic impact of changes. For example, if there is 15 minutes of reduction in loading time, what is the economic savings on labor, fuel, maintenance, and longevity of equipment? Be sure to include savings on all equipment utilized.

Are there opportunities to reduce feed shrink? What are the goals for the new facility? If one is moving from a current rate of 5 to a 2% goal, what will be required to reach the new goal? Moving from three-sided commodity storage to enclosed storage and loading can significantly reduce feed shrink and improve efficiency. Average wind speeds in the local area will determine the extent of the loss. Certain feeds may start moving at wind speeds of 5 MPH. While all regions of the US will experience this level of wind, some areas have much higher sustained winds than others do. These areas have a greater opportunity than those with less wind, but all will have an opportunity. In addition to protection from wind, moisture protection is essential in reducing shrink. If this is an issue with the current facility, what are the goals for a new facility?

Finally, in setting the goals for the new facility, perform a careful assessment of the current energy and labor usage. What are the opportunities for improvement? What new goals are being set? What types of equipment might need to be included to meet these goals? How will this work economically? What are the cost versus benefits in savings of energy, labor, and feed? These are difficult questions but are important in trying to understand and justify the added expenses for a new facility.

Site and Existing Facilities

With the goals and some of the requirements of the new facility identified, it is time to start looking at the potential site. Working close with engineers, carefully consider where to locate the facility in relationship to existing buildings and any future buildings. These are hard questions, but it is challenging to move the concrete in the future. The time to move things on the drawing board is now. Developing a complete site plan is important in establishing where the feed center should be located. Feed centers need to be located close enough to the pens to allow for efficient delivery of rations to the cattle. Reducing driving time from the feed center to the pens is an important efficiency factor in reducing time between loads and increasing the number of cows fed per hour.

Consider site drainage and topography. Moving dirt or filling is expensive, and if necessary, it is simply part of the cost for the site. However, minimizing site preparation costs by changes in location or design will reduce overall construction costs. Address these details at this stage of the planning process.

Future Facilities

Addressing the location of the feed center and future facilities can be a difficult task. It is generally helpful to assess the natural resources available to the site and the number of cattle potentially accommodated by these resources. Then utilize the data to determine the size and type of future buildings.

In designing the footprint of the feeding center, goals should provide a baseline to determine the types of storage and feed transport. The type of feed to be stored; dry, wet, and liquid or bulky ingredients determine storage type. Capacity of the individual bays, bins, or tanks is related to the number of animals and feeding rates. One important consideration is the all-in all-out or first-in first-out concept. Feed rotation should provide for the oldest feed to be fed first. This may result in multiple bins or bays for a feedstuff. Other considerations would be pull-through bays or the ability to dump new feed into the back of the bay.

Once the capacity and storage needed is determined, an accurate footprint of the feed storage center can be determined.

Traffic Patterns

Traffic patterns are important in this step. Keep in mind that the facility will mix and receive ingredients simultaneously. On most dairies, feeding and deliveries are during the daylight hours. Having a traffic pattern for feeding that does not interfere with the incoming feed is important. Stopping the feeding operation to accommodate feed delivery reduces feeding efficiency. For wet and bulky byproducts, this may be a challenge. However for dry feeds, separate traffic patterns should be possible. Use engineering professionals to determine the needed space for roads. Do not guess at these requirements. Over several decades, this facility will accommodate thousands of trucks. Trucks will not get smaller, so plan for larger trucks. In general, there may be five types of deliveries received by the dairy; hopper bottom trailers, walking floor trailers, dump trailers, liquid feeds, and enclosed trailers. The facility design needs to efficiently accommodate each of these.

Equipment

Equipment considerations include feed storage, feed transport, feed mixing, and feed delivery. The design and selection of the appropriate equipment should meet the efficiency goals for the new facility. In most cases, stationary mixers utilizing electric motors will reduce mixing time, improve energy efficiency, and reduce mixing errors. If feed delivery equipment does not contain mixing or processing equipment, this may avoid some of the issues with over-mixing. Sizing of the loaders and selection of the correct buckets is important to reduce the number of dumps into the mixer without reducing accuracy. Use of automation can reduce the number of mixer wagon adds and allows dry feeds to be delivered quicker.

Feed handling equipment for feed deliveries needs to match the type of trailers. Capacity of elevators or elevator legs needs to match the overall daily volume of deliveries. Due to the relative cost of this equipment, carefully consider future needs. If the center is going to expand in capacity, initial overbuilding may be necessary to meet future needs. In addition, consider if additional storage bays, bins, or tanks will be necessary for additional feed mixing capacity.

Location of silages and forages also needs to be part of the plan. Silage bunkers or piles will generally be located away from the feed loading site, and forages will be hauled from the silage storage area to the feed mixing area. Transporting feeds at least once daily with side-dump trailers is the most efficient.

If using side-dump trailers, design the feeding pad to accommodate this equipment. During active feeding, will forages be delivered to the feeding pad, and does the design accommodate these two activities. As the design is developed, consider the requirements for silage filling and packing. These two operations will occur at the same time. Considering harvest traffic flow in the planning will avoid issues later.

Technology

Today, the feeding system can include a great deal of technology to reduce labor and increase efficiency. Delivering dry feeds into the mixer without the use of a loader are just one benefit of a computerized batching system. These systems are more accurate and consume less energy than using a loader. They work best in conjunction with overhead storage and will reduce the number of loader additions to the mixer. With these systems, the only feeds that need to be loaded with a loader are the forages and wet or bulky byproducts. This generally reduces loading time by 10 to 15 minutes. When feeding 20 or more loads per day, this is a very significant time and machinery savings. Application of technology has many benefits and will impact the design of the total system.

Shrink

Reducing feed shrink is a major consideration in the design process. Again, refer back to the goals established in the beginning. What is the desired reduction in shrink? The use of overhead storage or bins greatly reduces the shrink on dry ingredients. Utilizing an enclosed feed loading area will also reduce shrink. New facilities should strive to reduce dry feed shrink to less than 2%. Newer commercial feed mills often reduce shrink to less than 0.5%.

Safety

During the design process, consider safety issues associated with equipment and personnel. Provide for designated paths for people and wheeled equipment. Consider blind corners for equipment operators and utilize mirrors if the blind corners are in the design. Keeping the flow of feeding equipment and delivery equipment separate will reduce the chances of safety issues. Location of fire protection equipment should also be considered. Fires in the feed mixing facility can be costly and put the herd in jeopardy. Air quality is another consideration in enclosed facilities. Dust generated by feed loading, mixing, and delivery can reduce air quality, and under some conditions, result in fires or explosions.

Loading Efficiency

In the design process, loading equipment needs to be determined. Sizes of buckets on loaders is important to reduce the number of trips between the feed and the mixer wagon. Application of technology to deliver some ingredients to the mixer via computer controls will improve loading efficiency. Reduced loading time increases efficiency and reduces equipment and labor expenses. Consideration of distances between feedstuffs and the mixer are critical design criteria. Utilizing engineers can avoid excess space without limiting the normal operation of equipment.

Delivery Efficiency

Once mixed, the system should allow for efficient delivery to the bunk. Correct sizing of delivery equipment to match the mixing equipment will allow for efficient transfer of materials between the two systems. Consideration of a dump mechanism or unloading systems between the stationary mixer and delivery equipment is the final step. Consider time, maintenance, and overall design criteria. Dump systems can reduce the maintenance of chain elevators and transfer time reduced.

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