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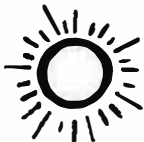
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MIXER EQUIPMENT OPTIONS FOR TOTAL MIXED RATIONS

by

Larry W. Turner, Extension Agricultural Engineer

The use of total mixed rations (TMR) in the dairy industry provides dairymen with the ability to feed a blended, balanced ration. TMR rations are balanced for the particular requirements of a specific group of cows or calves. Several different options are available for types of equipment to mix TMR rations. These types of equipment include assorted designs for both portable and stationary mixers, different types of scales and various types of conveyors.

Types of Mixers:

There are several different designs for mixers (or blenders) available on the market. The choice of the design depends upon the types of forages or commodities to be mixed, the power requirements of the unit, the price, and the level of service offered by the local dealer or distributor.

Figure 1 illustrates simplified diagrams of various mixers. These mixers may be either used in stationary or portable applications. All mixers consist of a box or tank to hold the feed ingredients, a mixing device and a weighing device. The three main types of units are; auger mixers, reel mixers and tumble, or drum, mixers. Table 1 summarizes common specifications for the various mixer types. More specific information for a particular brand of mixer is available from the manufacturer.

TABLE 1. APPROXIMATE STATIONARY MIXER SPECIFICATIONS ¹						
Rated Mixer Capacity (ft ³)	Length (feet)	Width (feet)	Height (feet)	Discharge ² Height (inches)	Loading ² Height (inches)	Horsepower Required (HP)
Drum or Tumble Mixer						
100	10	7	7	24	60	3.0
200	14	8	8	36	72	5.0
300	16	8	9	36	72	7.5
Reel Mixer						
100	7.5	7	5.5	16	top	7.5
200	11.5	7	5.5	16	top	15
300	12.0	8.5	7.0	22	top	25
Auger Mixer						
100	9	6	7	bottom	top	5.0
200	12	6	7	bottom	top	12.0
300	14	8	7	bottom	top	25.0
¹ Consult manufacturer's literature for more specific information.						
² For portable mixers, add additional height (typically 14" - 20") for elevation of trailer bed.						

Auger Mixer

Horizontal auger mixers use three or four augers to churn the feed in a hopper moving it along the flights, (Figure 1). One or two of the augers is counter-rotating moving feed opposite to an adjacent auger which provides the mixing action. Knife sections attached to the auger flights provide the ability to cut or tear long hay into 3-4" pieces and mix it into the ration. Auger mixers generally provide a more aggressive mix than the tumble mixer. As the auger flights wear, the mixing time may have to be increased to obtain a uniform mix.

Reel Mixer

The reel mixer combines a set of augers and a reel similar to a combine reel in a hopper, (Figure 1). Feed is lifted and tumbled by the reel moving it to the counter-rotating augers which also provide a mixing action. Knife sections on the auger flights cut or tear long dry hay into 3-4 inch pieces and mix it into the ration.

Tumble Mixer

There are several types of tumble or drum mixers (Figure 1). Spirals and pans on the circumference of the drum lift and tumble the ration. Loading and unloading occur at different ports on the mixer. Some designs also use a central auger which circulates feed moving it to the front of the mixer where it either is remixed in the tumbling action or delivered to the conveying equipment at the same loading and unloading port. Tumble mixers generally have less wear and lower power requirements than auger mixers of the same capacity. Dry hay must be chopped to a 1-3 inch cut before it can be mixed in the tumble mixer.

Sizing the Mixer

In mixing TMR rations, a recipe is followed and feed ingredients are added one at a time until the required weight of each specific ingredient is reached and the batch is complete. The mixer size is dependent on the group size and the number of times each group is fed. Table 2 shows the approximate required mixer size based on group size and the number of times groups are fed per day.

TABLE 2. MIXER SIZING ¹					
Number Feedings Per Day	GROUP SIZE				
	20	40	60	80	100
	Mixer Size ft ³				
1	100	200	300	400	500
2	50	100	150	200	250
3	33	67	100	133	167

¹Assumes 50 lbs. D.M. per cow per day. Feed ration weights 20 lbs/ft³ at 50% M.C. Approximately 5.0 ft³ per cow per day.

The struck or level capacity of a mixer is the total volume of the mixing compartment. Mixers are rated from 60-90% of the struck level capacity of the mixer depending on the manufacturer. A good "rule of thumb" is to buy a mixer based on 60-70% of the struck level capacity of the mixer. Overloading mixers above their rated capacity increases the required mixing time to obtain a uniform mix. In tumble mixers, free space is needed to allow ingredients to tumble. Overloading an auger mixer will cause some feed to fall out of the mixer. Recommended mixing time ranges from 3-6 minutes. The time required to fill and unload the mixer is dependent on the conveying equipment used to deliver feed to and from the mixer.

Portable vs. Stationary Mixers

There are both advantages and disadvantages for either portable or stationary mixers. The use of stationary mixers is most common where upright silos and mechanical conveyors are used for moving feeds, and where all feeding operations are done relatively close to the mixer. Portable feed wagons can be used, however, with a stationary mixer to deliver TMR rations to remote sites. Portable mixers work well with flat silos and commodity storage structures and where feed storage and/or feeding operations are distributed over the farm.

Portable mixers also offer greater flexibility in the event of a breakdown of the mixing equipment. If the portable mixer breaks down, a feed or silage wagon can be used as a temporary substitute to mix and transport feed. With a stationary mixer, the conveyor system often doesn't allow such a temporary arrangement. Front-end loaders are more readily adaptable to portable mixers. With stationary mixers, a hopper must be provided and material conveyed into the stationary mixer from a front-end loader. Of course, portable trailer or truck mounted mixers require a mobile power supply, while stationary units typically use electric motors as the power source.

Scales

Scales are required on a mixer to properly weigh and blend the ration.

Electronic digital readout scales use load cells to weigh ingredients in the mixer and are accurate to 0.25%, or ± 5 lb in every ton. Dust and moisture can cause malfunctions if the unit is not sealed properly. Beam scales, a mechanical means of weighing, are accurate to 1% (or ± 20 lb in one ton) and can better withstand the environment. Fluid scales are simple but not as accurate and can be used to read at remote locations from the mixing site as can electronic scales. Elevate the mixer 6-12" off the floor to prevent dirt and feed build-up from causing inaccurate scale readings. Spring scales for small amounts of ingredients such as salt, vitamins, and additives can be used to weigh these materials before adding them to the batch.

Conveying Equipment

Conveying equipment is a major part of the total mixer system and should be well planned to obtain an efficient feeding system. Conveying equipment capacity must be matched to the other equipment in the system. The conveyor must be able to convey feed faster than the unloading equipment or mixer can deliver it to reduce overloading and spilling feed. A separate accumulator weigh box above a stationary mixer speeds up delivery of feed from upright silos because the bulkiest material is pre-weighed for the next batch. This reduces time waiting for slow silo unloaders.

Belt conveyors have a high capacity and are commonly used to convey silage from upright silos to mixers. Textured belts can elevate feed at an incline but the capacity is reduced and feed may roll back off the conveyor. Chain and flight conveyors are generally lower capacity than the belt conveyors but they can elevate feed over relatively short distances at a steeper incline. Reversing motors on conveyors allow the flexibility of moving feed in two different directions with the same conveyor.

Front end loaders are readily adaptable for use in flat feed storage systems with portable mixers. For stationary applications, an additional hopper and conveyor is usually needed to use flat storage with front-end loaders. Another option is to use a feed transport wagon loaded at a remote site and then empty the feed into a conveyor at the stationary mixer site. Conveyors can also then deliver the mixed feed from a stationary mixer to a feed wagon for remote feeding. The portable mixer removes some steps in that process by serving as part of the feed transport system as well as mixing the ration.

Summary

TMR mixers and associated equipment are available in many different types and sizes to fit the needs of a particular dairy. Every dairyman installing a TMR system must consider his own unique requirements in choosing the TMR equipment best suited to his or her farm.

Acknowledgments

Portions of this publication are excerpts from Kammel and Leverich, 1990.

References

Kammel, D.W. and J.B. Leverich. 1990. Stationary mixer systems for total mixed rations. pp. 155-165 In: Proceedings from the Dairy Feeding Systems Symposium, Harrisburg, PA; Northeast Region Agricultural Engineering Service, Ithaca, NY. January.

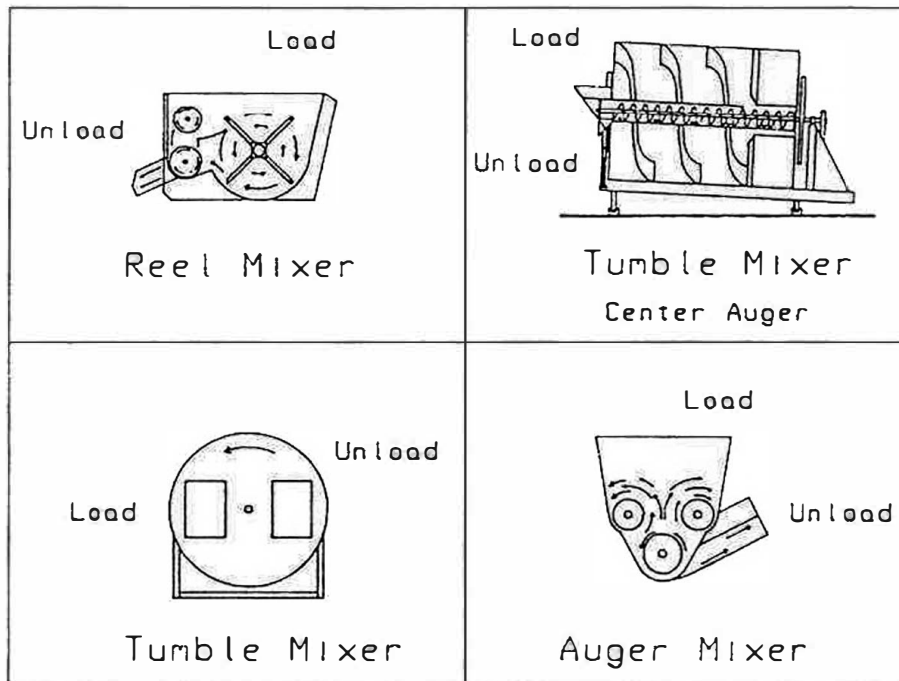


FIGURE 1. Types of T.M.R. mixers (from Kammel and Leverich, 1990).