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Abstract

A "rotating drum" type mixer was tested to determine if it could produce a uniformly mixed feed. Feed was manufactured in four separate trials, which examined addition sequence, mixing time, mixer capacity, and liquid addition. Uniformly mixed feed was obtained after 8 min, when ingredients were properly sequenced and mixed. Smaller batch sizes decreased the time required to obtain a uniform mixture. The mixer distributed liquid uniformly through the feed and had excellent clean-out capabilities.; Swine Day, Manhattan, KS, November 21, 1991

Keywords

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EVALUATION OF A ROTATING DRUM MIXER[1]

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Summary

A "rotating drum" type mixer was tested to determine if it could produce a uniformly mixed feed. Feed was manufactured in four separate trials, which examined addition sequence, mixing time, mixer capacity, and liquid addition. Uniformly mixed feed was obtained after 8 min, when ingredients were properly sequenced and mixed. Smaller batch sizes decreased the time required to obtain a uniform mixture. The mixer distributed liquid uniformly through the feed and had excellent clean-out capabilities.

(Key Words: Rotating Drum Mixer, Feed Uniformity, Feed Manufacturing, Mixer Testing.)

Introduction

Properly designed mixers have the potential to produce uniformly mixed feed. However, the time required to produce a uniform mixture varies between mixer classes. Mixers also vary considerably within a class. Therefore, it is essential that all mixers be evaluated for their ability to produce a uniformly mixed feed, time required to produce a uniform mixture, and completeness of clean-out.

Rotating drum mixers have become increasingly popular for farm applications. Low energy consumption, good clean-out, and the ability to produce uniformly mixed feed has made these mixers popular. Because of their increased use and the lack of information on these mixers, a study was needed to evaluate their ability to produce uniformly mixed feed. The study was designed to determine the appropriate mixing time, proper ingredient sequence, batch size, clean-out, and liquid application for a "rotating drum" mixer.

The study was divided into four trials. Trials I and II investigated the effect of ingredient sequence addition on mixing time. Trial III examined uniformity of partial batches and liquid addition. Trial IV determined mixing time required from a dead stop after ingredient addition.

Procedures

Mixer uniformity tests were performed on a drum mixer with a capacity of 38 ft^3 and rotating at 7 RPM. Sequence of ingredient additions in Trial I was sorghum, soybean meal, wheat midds, and premix.

The sequence was reversed in Trial II. Trial III sequence was soybean meal, premix, wheat midds, and sorghum. In each trial, the assay ingredient, salt, was included in the premix.

A sow diet with an apparent bulk density of 36.25 lb/ft^3 was used for all mixer uniformity tests (Table 1). Ingredients were added to the mixer while the drum was rotating in Trials I through III. A 4 in. screw conveyor was used to fill the mixer. Fill time was between 8 to 10 min for the 1500 lb batch. Mix times began

[1]A special thanks to the 1991 Feed Technology II class for helping conduct the research.
[2]Department of Grain Science and Industry.

after the last ingredient addition. The mixer was stopped and sampled at designated times (*Tables* 2 and 3). Ten, 50-g samples were obtained from the same location in the mixer each time it was stopped. Samples were analyzed for salt content with the Quantab^R Chloride Ion test. Coefficient of variation (CV) values < 10% indicate a uniformly mixed feed for the Quantab^R Chloride Ion test.

Trial III involved production of 500-, 1000-, and 1500-lb batches of feed. The feed was sampled at 4, 8, 12 min and discharge. Choice white grease (2.9%) was applied to the 1500 lb batch of feed after it was dry mixed for 12 min. The feed was mixed for an additional 5 min after the fat was added. Samples for crude fat analysis were taken at the discharge.

Ingredients were placed in the mixer without the drum rotating in Trial IV. The mixer was started after the last ingredient and sampled at 4, 8, 12 min and discharge.

Results and Discussion

Results for mixing time are presented in Table 2 for Trials I and II. When the premix was added last, mixing time required to obtain a uniform mixture was not accomplished until discharge (11 min). When the premix was added first, 8 min were required to produce a uniform feed. The table indicates that the feed was uniform at 1, 2, and 4 min, but visual examination as well as variablity between replications indicated that the mixer did not consistently produce a uniform feed at those times. In addition, adding the premix first caused problems with dead spots and premix loss.

Trial III showed that adding the premix second resulted in a uniform mix after 8 min (Table 3). In addition, it eliminated mixer dead spots and premix loss. The results also indicate that rotating drum mixers can mix batches that are less than rated capacity. Mixing time decreased as batch size decreased.

The fat was evenly applied throughout the 1500 lb batch. Crude fat analysis ranged from 3.28 to 3.64% on 10 samples. The results indicate that the mixer is capable of uniformly distributing liquids.

Starting a 1000 lb batch from a dead stop after all ingredients were added produced a uniformly mixed feed after 8 min. At 4 min, the coefficient of variation was 11%, when < 10% is desired. Therefore, a uniform feed can be produced between 4 and 8 min from a dead stop.

The study indicates that rotating drum mixers are capable of producing a uniform batch of feed when used properly. With the type of mixer used in the present study, uniform feed can be produced after 8 min. Mixing time can vary between mixers; therefore, it is necessary to test every new mixer. Mixers should be tested annually to determine if current mixing procedures are satisfactory. Factors such as equipment condition, ingredient sequence, batch size, ingredient particle size, and density all affect mix time.

Table 1. Sow Diet

Ingredients	Percentage
Ground Sorghum	66.35
Soybean meal 44%	15.00
Wheat midds	15.00
Dicalcium phosphate	1.60
Limestone	1.20
Salt	.50
Vitamin premix	.25
Trace mineral premix	.10

Table 2. Calculated CV's (%) for Ingredient Addition Sequence

Mix Time (min)	Trial I[a]	Trial II[b]
1	111.93	9.82[d]
2	74.83	8.00[d]
4	35.26	9.51[d]
8	11.96	8.46
Discharge[c]	9.99	6.21

[a]Sequence sorghum, SBM, wheat midds, premix.
[b]Sequence premix, wheat midds, SBM, sorghum.
[c]Discharge rate of 500 lb/min.
[d]Visial inspection of the feed and variablity between replications indicated that feed may not be consistently uniform at these times.

Table 3. Calculated CV's (%) for Different Batch Sizes and Starting from a Dead Stop

	Batch Size[a]			
Mix Time (min)	500 lb	1000 lb	1500 lb	Dead Stop[b]
4	6.13	5.82	7.50	11.11
8	9.21	7.12	5.66	6.21
12	8.88	6.05	6.93	5.05
Discharge	8.27	7.66	7.45	7.27

[a]Ingredients were added while the mixer was rotating.
[b]Ingredients added prior to starting the mixer.