

8.1.1. Validation of Mixer Efficiency

Standard

Are there records confirming the mixer has been tested for mixing efficiency in the last 12 months?
The intent is to have mixers that achieve a homogenous finished product. Regular mixer efficiency testing should be conducted, preferred 6 monthly checks.

Purpose

The operator shall be able to verify their mixers achieve a homogenous finished product.

Reason

Mixers are used in feed manufacturing to blend raw materials in a liquid or dry form. The intent is for mixers to provide a homogenous mix that is transferred to the next stage of production. The inherent nature of raw material variability is difficult to control, therefore stock feed manufacturers should be able to demonstrate a record of validated mixing process.

Finished feeds supplied to customers can be affected by poorly designed or maintained conveyors, elevators, augers, holding bins and silos can result in separation of materials. It is equally important to ensure no post-mixing separation occurs.

What is Acceptable?

A procedure that provides instructions for testing mixer efficiency and retention of mixer efficiency testing records. The procedure must list the ingredient or nutrient used for testing and a list of actions required when CV is not within acceptable limits.

Homogenous mixing revalidation shall be performed at least annually for each mixer/process line. However, six monthly is recommended. The product used for the validation must be representative of products made, where a wide range of products are produced then the mixing validation program should be designed to ensure a representative sample of the product range is tested.

It is recommended that validation studies are presented in a report style format with the following headings at a minimum:

- Date.
- Purpose of validation.
- Method being used.
 - Sampling (number of samples, where they are being taken from, etc).
 - Test being performed (e.g. ABC Laboratory to test copper and zinc content).
- Results.
 - Raw data.
 - Calculations.
- Discussion.
 - Note any deviations or outliers.
 - Note any patterns of interest.
 - Compare results to last test.
- Conclusion.
 - Statement on compliance.
 - Statement on next test plan.
- Approvals / Signature of review.

Measures of Homogenous Mixing

Mixer efficiency is based upon taking samples that are analysed for a defined raw material or nutrient, with statistical analysis completed to determine the standard deviation and co-efficient of variation. The co-efficient (CV) of variation provides a measure that is comparable between mixer sizes. The interpretation of CV shown below should be used in interpreting test results. The goal is to have a CV less than 10%.

Table 1. Coefficient of Variation Interpretation – Feed Mixers. Note: Manufacturers of premixes and medicated feed concentrates a CV of less than 7% is required.

CV %	Rating	Corrective Action
< 7	Excellent (TARGET)	n/a
7 - 12	Good	Nil. Improvements required.
12 – 15	Marginal	Nil. Improvements should be scheduled immediately.
15 – 20	Poor	Poor mixer efficiency, initiate a CORRECTIVE ACTION* Procedure
> 20	Poor	Initiate a CORRECTIVE ACTION* procedure

*See Fact Sheet 10.2.1

Efficiency Testing Methodology

Within this Fact Sheet are directions on how to complete a mixer efficiency test, this being taken from the *EU Guide to Good Practice for Feed Additives and Premixtures Operators v2 17/01/2007*. The following additional notes are provided.

1. The feed selected for testing should be a typical product, representative of the feed products being manufactured. If the site manufactures a wide range of differing feeds, it is advisable to repeat the mixer efficiency test using differing feed types. i.e. high roughage feeds may mix very differently from heavy mineral based concentrates.
2. The test must be conducted using the normal mixer cycle time of mixer filling, mixing and emptying. The test results need to reflect the real mixing situation.
3. Selection of the ingredient or nutrient for analysis can be either:
 - a. Mineral – such as chloride where salt is added to the feed at levels > 0.5kg/tonne. If using salt as the test material, utilise fine salt as coarse salt particles can bias the results.
 - b. Trace Mineral – copper or zinc where these minerals are added to feeds at levels above that typically supplied in vitamin/mineral premixes.
 - c. Medication – some medication suppliers can assist in assessing mixer efficiency.
 - d. Micro Tracers – products manufactured for inclusion in feed to assess mixer efficiency. Typically dye coloured iron particles that can be identified in finished feed.
 - e. Do not use nutrients such as protein, fat or fibre to assess mixer efficiency as these nutrients are present in many raw materials.
4. To increase the sensitivity of the test, two different nutrients can be analysed, for example test samples for both a trace mineral and a medication.
5. Laboratory Testing - ensure the laboratory has sufficient capability in performing the required analysis. Some medications are difficult to assay, and the analysis error may greatly influence the mixer efficiency test results.
6. Sample collection – samples need to be collected either directly from the mixer or as the mixer empties.
 - a. Where samples are taken as the mixer empties, a minimum of 10 grab samples should be taken at even time spacing as the mixer discharges. Note that as feed is transferred via conveyors, elevators and augers feed separation may occur. The emphasis is on testing the mixer and the further the sampling point is from the mixer, the greater the chance of feed separation.
 - b. Where access to the top of the mixer is possible, when stopped take a minimum 10 spear samples from different areas of the mixer.
7. Co-efficient of Variation Calculation – it is important having obtained the sample results to calculate the CV. Results from each mixer efficiency test should be kept on file.
8. What to do if not right?

Post Mixing Segregation

It is equally important to ensure finished feed supplied is homogenous and no post-mixing segregation occurs. A similar process for finished feed can be used as that employed for the mixer efficiency test. Finished feed samples are collected for analysis and CV calculated.

Unacceptable CV - Actions to take

If the mixer is found to provide unacceptable CV as listed in table 1., the following actions can be taken:

- Consult with the manufacturer that supplied the mixer.
- Modify mixer cycle times, increasing time to provide acceptable CV. With some mixers OVERMIXING can cause separation too.
- Review mixer filling and sequence of ingredient filling.
- Mixer may be over filled, where bulkier ingredients are in use, mix size may need to be reduced.
- Review addition of liquids and use of spray nozzles.
- Consult with your premix and/or medication suppliers who can often provide additional advice on mixing efficiency.

Testing Protocol

Further Guidance on Homogeneity - Annex 5 of EU Guide to Good Practice for Feed Additives and Premixtures Operators (Version 2, 2007). <https://www.eesc.europa.eu/sites/default/files/resources/docs/131-sante-community-guide-to-good-practice-for-feed-additive-and-premixture-operators-version-2.pdf>

Co-efficient of Variation (CV) Calculation

Co-efficient of variation (CV) is the standard deviation expressed as a percentage of the mean so it takes into consideration the size of the sample.

$$CV = \left(\frac{\text{Standard deviation}}{\text{Mean}} \right) \times 100$$

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