

Results of plant carry-over assessment testing

The tests described in this datasheet were carried out between 1992 and 1994 as part of the risk assessment on the use of additives in animal feed. The production lines trialled in the first two tests were adapted so as to create situations involving risks of carry-over.

1. Test 1

1.1. Protocol

This test was designed to assess the impact of using a grinder's aspiration function to capture the air above and below an additive feed pit (Figure 1). Theoretically, all the fine particulate matter collected via this aspiration should fall back into the circuit after grinding.

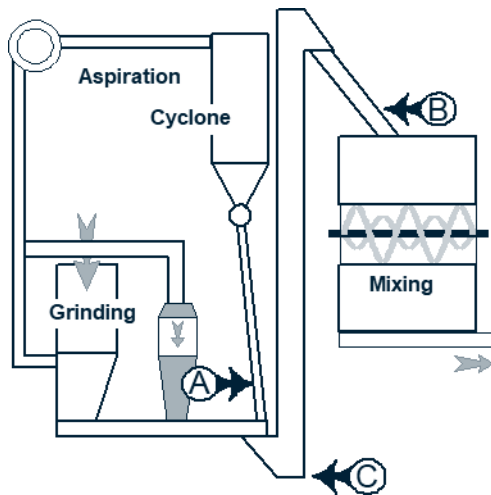


Figure 1: Diagram of the line trialled in test 1

After running a rinsing batch (No.1) through the system, the amount of carry-over was assessed by running through a 4-ton tracer batch (No.2) containing 100 ppm of Monensin followed by two 4-ton collector batches (Nos 3 and 4) that were initially free of Monensin. Samples were taken at three points on the line (Figure 1):

- at the cyclofilter output (A) during batch throughput.
- at the hopper input on the mixer (B) during batch throughput.

- at the base of the elevator (C) after each separate batch throughput. The base of the elevator was therefore emptied after each batch.

These samples were quickly scanned for ionophores, using a detection threshold of 5 ppm. Next, the Monensin dosage was determined for the samples that tested positive during the quick scan.

1.2. Results

No ionophores were detected in the rinsing batch (No.1).

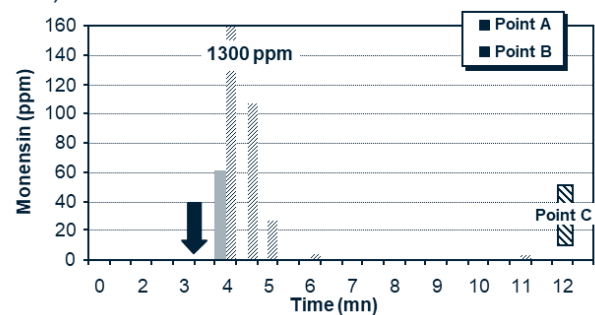


Figure 2: Results for tracer batch (No.2) of test 1

During throughput of the tracer batch (No.2), the Monensin, fed into the circuit at time 3.5 minutes (arrow in Figure 2) appeared rapidly on a peak of 1300 ppm at the mixer input (Location B) and remained visible for 2.5 minutes.

Fines containing Monensin arrived at the cyclofilter output (Location A), 30 seconds after introduction of the premix.

The peak concentration ratios suggest that 4.6% of the additive passed into the aspiration system.

A small peak was observed at location B (3.3 ppm) at the end of batch throughput. This peak could have been caused by massive declogging at the end of batch throughput after closing the suction system. Likewise, carry-over was identified at the base of the elevator (Location C) following tracer batch throughput. This carry-over was undoubtedly similar to the situation that routinely occurs at the plant.

While no traces of Monensin were detected in the collector batch (No.3), some traces were found in

the base of the elevator. It should be noted, however, that as the base of the elevator was cleaned after throughput of the tracer batch (No.2), it was not possible to measure the level of carry-over in the first collector batch deriving from the base of the elevator.

During throughput of the second collector batch, traces of Monensin were recorded along the whole line and in the base of the elevator.

This production line configuration could therefore have generated slight, but widespread, carry-over in both batches that followed throughput of a tracer batch, due either to deposits in the elevator, or due to declogging of the aspiration system.

Due to the base of the elevator being cleaned after throughput of the tracer batch (No.2), the risk of carry-over via the base of the elevator has probably been underestimated.

2. Test 2

This test was designed to assess the effect of incorporating an additive prior to the grinding process (Figure 3) in a diagram fitted with a rotary sieve shaker upstream of the grinder. This system should extract the additives from the product being sent to the grinder; the fines are added back to the ground product at the base of the elevator that carries the mix to the hopper on the mixer.

2.1. Protocol

A 2.5 T batch of rabbit feed containing 300 ppm of DMZ (batch No.2) was used to assess the magnitude of the carry-over risk. The circuit was rinsed with a preliminary 2.5 T batch of beef cattle feed supposedly free of DMZ (batch No.1). Two 2.5 T batches of beef cattle feed (batches No.3 and No.4), likely to receive carry-overs, were fed through the same circuit after the tracer batch. The DMZ has a particle size of 446 µm, at the limit of the sieve shaker's capabilities, as the expected particle size of the feeds is approx. 500 µm. Samples were taken during each batch throughput at the following points (Figure 3):

- Point A: product conveyance prior to grinding
- Point B: at the grinder output
- Point C: at the sieve shaker output for fines
- Point D: at hopper input on the mixer

2.2. Results

The results are shown as mean concentrations of DMZ identified at each sampling point (Table 1): for batch No.1 as a whole, at points A, B, C and D.

- for the first (1) and second half (2) of the throughput time for batches 2 and 3, at points A, B, C and D.
- for the first half of the throughput time for batch 4, only at points B and C.

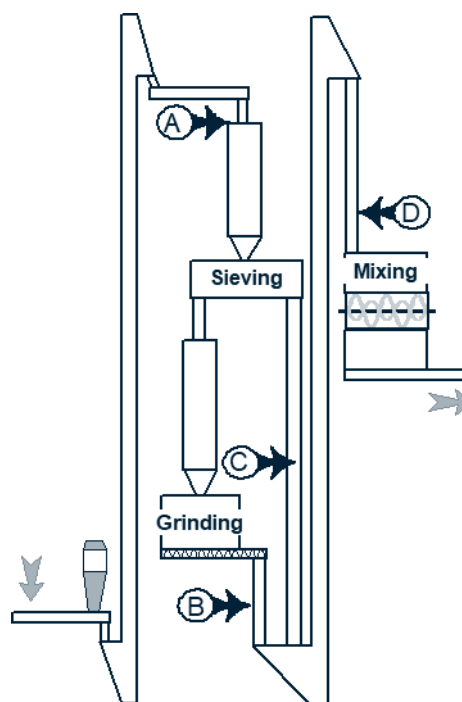


Figure 3: Diagram of the line trialled in test 2

After analysing and checking the operations, it appeared that the beef cattle feed batches (No. 1, No.3 and No.4) contained a low dosage of DMZ due to the incorporation of recycled feedstuffs. This concentration was determined based on the dosage of DMZ in rinsing batch No.1 (Table 1), which was measured at 4 to 5 ppm. Next, the level of carry-over in batches No.3 and No.4 was analysed against a baseline concentration of 4 to 5 ppm of DMZ in these two batches.

The results of tracer batch No.2 revealed that:

- the major part of the DMZ dose passed through every sampling point during the first half of the throughput time.
- this demonstrated that some DMZ carried over into the grinder despite the feedstuff having been sieved upstream of the grinder.

In the next two batches (No.3 and No. 4), the concentration in DMZ at the output of both the sieve and the grinder exceeded the fixed threshold (batch No.1).

A detailed analysis of the first collector batch (No.3) revealed that carry-over in the grinding circuit (point B) was massive in the first sample (760 ppm), and then decreased rapidly. In the fines circuit (point C), the level of carry-over was lower at the beginning of batch throughput, but persisted over a longer period. There was little evidence of this carry-over mechanism at point D.

Points	A	B	C	D
Batch 1	3.6	2.8	5.4	4.1
Batch 2	1 127.3	308.0	1105.9	585.8
	2 5.0	19.4	41.5	22.2
Batch 3	1 2.7	89.6	63.8	6.3
	2 8.1	2.1	6.1	5.7
Batch 4	1 -	14.8	9.0	-

Table 1: Mean concentrations of DMZ (ppm) in the batches for test 2

In the second collector batch (No.4), the first sample taken at location B showed a high concentration of 71 ppm.

This test revealed the sieve shaker's poor performance in terms of DMZ extraction and a high level of carry-over at the grinder.

3. Test 3

The purpose of this test was to use three internal tracers to measure:

- the carry-over that occurs between a mixer and the entry to a silo bin upper the press in an animal feed plant (Figure 4).
- to what extent the sampling technique influences carry-over assessments.

3.1. Protocol

Three batches of duck feed were used as tracer batches. This feed contained 2% of fat added in the mixer. The carry-over generated on the following three batches of 5 T each (1, 2, 3) was assessed using three internal tracers incorporated into each tracer batch: dimetridazole at 300 ppm (DMZ), manganese sulphate at 300 ppm (SMn), zinc sulphate at 1000 ppm (SZn) (Table 2).

Tracers	DMZ	SMn	SZn
Particulate matter density (g/cm ³)	1.40	2.90	3.22
Tap density (g/cm ³)	0.57	1.13	1.43
Median diameter d50 (µm)	37.0	118.3	387.4

Table 2: Characteristics of the tracers used in test 3

The raw materials were sampled at the grinder output (point A) before adding the last two tracers (zinc and manganese); this was because these tracers could also be found in the raw materials. The results of the analyses made it possible to estimate the concentration of these two oligo-elements in the raw materials.

To assess the level of carry-over in the three collector batches, thirty primary samples were taken during throughput of the last tracer batch at point B and the three collector batches at point C.

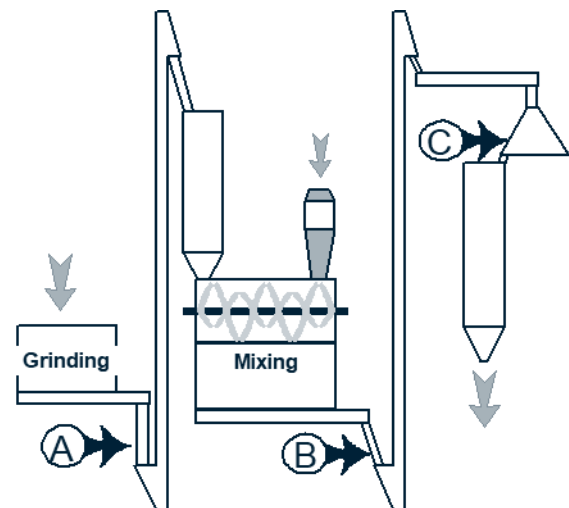


Figure 4: Diagram of the line tested in test 3

The analyses were performed either directly on the primary samples, or on the aggregate samples formed by grouping identical fractions of primary samples.

In order to compare the tracers one against the other, the carry-over level was expressed as a percentage of the tracer concentration in the final tracer batch. For the two oligo-elements, this calculation was made by subtracting the concentrations deriving from the raw materials.

3.2. Results

3.2.1. Carry-over

The first collector batch appeared to receive carry-over from start to finish of its throughput, with there being observable differences in how the minerals and the DMZ behaved (Figure 5). The batch containing DMZ (◆) appeared to receive a higher level of carry-over at the start (3%) and at the finish (2%). In the batch containing the minerals, however, the carry-over peak was observed only at the start, but at differing levels for manganese (4.5% -○) and zinc (2.5% -□).

In the second collector batch (Figure 6), carry-over was detected with the DMZ at the start (1.8%) and at the finish (0.5%). Carry-over of the two oligo-elements appeared to be continuous throughout the whole batch at a level of 0.5% for zinc and 2% for manganese. This carry-over remained at approx. the same level during throughput of the third, and final, collector batch (Figure 7), but appeared null for DMZ. This could be explained by assuming a default estimation of the oligo-element concentration in the raw materials.

However, the levels of manganese and DMZ showed a peak at the end of the last collector batch throughput.

These peaks reveal the presence of a residual carry-over.

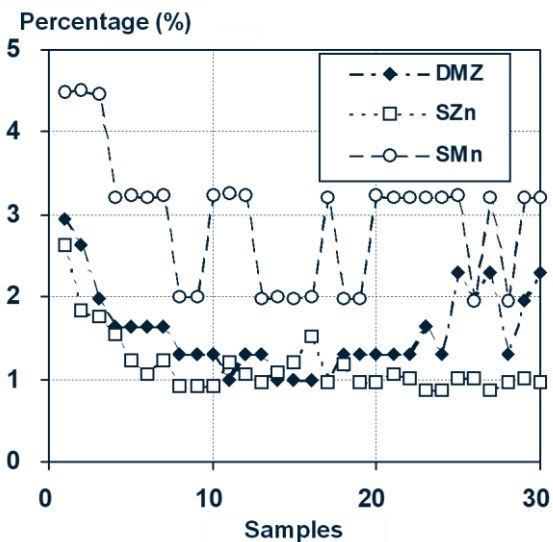


Figure 5: Results for the first collector batch of test 3

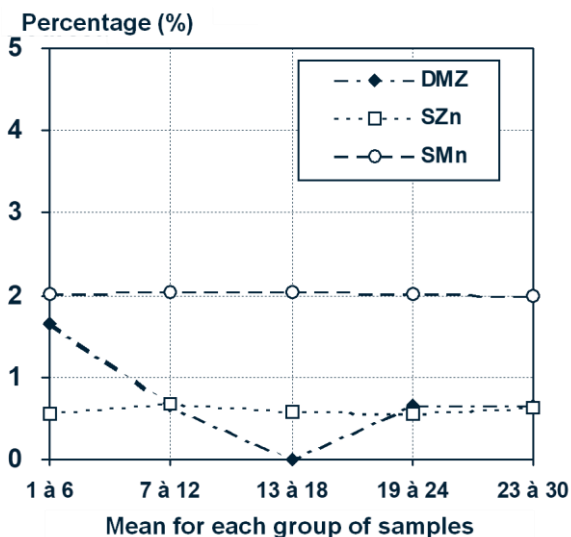


Figure 6: Results for the second collector batch of test 3

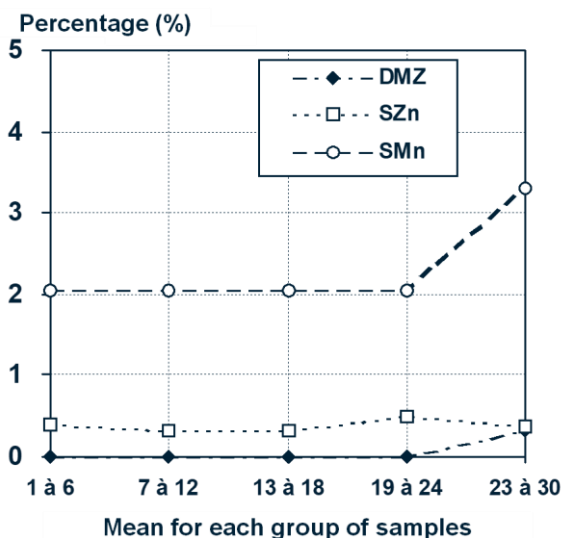


Figure 7: Results for the third collector batch of test 3

3.2.2. Sampling technique

For the first collector batch, the level of carry-over could be estimated for each tracer:

- by the mean of the 30 analyses performed on all the primary samples.
- by the mean of the 5 analyses performed on the 5 aggregate samples made up by mixing identical fractions taken from 6 successive primary samples (1 to 6, 7 to 12, etc.).
- by the result of a single analysis performed on an aggregate sample created by grouping identical fractions of the 30 primary samples.

Whichever tracer was used, the results (Table 3) show that a meaningful assessment of the level of carry-over can be achieved by forming a single aggregate sample.

Tracers	DMZ	SMn	SZn
Mean /30	1.6	2.9	1.2
Mean /5	2.2	3.5	1.2
Mean /1	1.6	3.2	1.4

Table 3: Carry-over levels in the first collector batch assessed using various sample processing procedures.

To sum up, the various tracers did not provide identical representations of the carry-over levels in a given circuit. Carry-over can, however, be assessed by taking a large number of primary samples of identical size and grouping them to form a single aggregate sample for laboratory analysis.

4. General conclusion

These tests revealed that certain diagram set-ups could result in carry-over:

- additives falling into the base of the elevator.
- unclogging of aspirated matter that contains additives.
- incorporation of additives prior to grinding.

The tests also showed that residual carry-over may persist in a circuit over a long period of time.

Lastly, the tests made it possible to develop and propose a procedure for assessing carry-over levels that could be used by the industry as a whole.

5. Find out more

Special Tecaliman report: Report 2 - Convention programme - SYPRAM No. 6 - June 1995.