

Aerobic spoilage of silage: part two – minimising losses

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Part 1 of this article (IDT Vol 8 No. 5) covered the extent of aerobic spoilage losses, the micro-organisms responsible and the factors that make silages susceptible to aerobic spoilage. Part 2 outlines actions that can be taken to minimise dry matter losses due to aerobic spoilage.

Aerobic losses can occur at any stage of silage production and feedout provided oxygen is available but the biggest potential losses occur from the activities of yeasts and moulds at feedout. Management decisions at ensiling as well as feedout will affect them. Here are a few tips on how you can minimise these losses.

Clamps – ensiling

- **Clamp preparation.** Clean the clamp thoroughly, repair any gaps in the walls and line them with polythene, leaving enough extra to allow a minimum 2m overlap with the top sheet when you seal the clamp.
- **Rapid wilt.** For grass aim for 30% DM in 24 hours by conditioning at mowing and spreading the crop thinly over the maximum area by tedding and raking. If it is not drying, pick it up immediately as leaving it in the field will only increase respiration and leaching losses. Rotting grass is also a good source of spoilage fungi.
- **Short chop.** Shorter material compacts better but consider all forages being fed so there is adequate physically effective fibre in the diet. Ensure the knives are sharp and for grass at 20-30% DM, chop to 2.5-5.0cm; for very high DM crops, shorten this to 1.5-2.5cm to aid compaction. Maize can be chopped as short as 1.0cm unless feeding at a high rate when this should be increased to 1.5-2.0cm.
- **Fast filling.** Faster filling and sealing reduces the time forage is exposed to air initially, reducing yeast numbers at opening. Sheet the clamp overnight or if there are any prolonged delays. If you do not you are likely to see layers of dark, spoilt silage at feedout. Do not delay final sealing of the



Finishing off with touching tyres.

clamp until the next day – the faster it is sealed the sooner the air gets used up and fermentation begins.

- **Good compaction.** This minimises air trapped initially and reduces the rate of air penetration at feedout. Fill in thin, even layers (maximum 15cm) as consolidation is only effective down to about 20cm, even with the heaviest machinery. Roll continuously, paying particular attention to the shoulders, and use single wheeled loaders to maximise the pressure per unit surface area; double wheels or tracks simply spread the weight. Increasing the tyre pressure will also increase surface pressure. Make sure you have enough machinery on the clamp to keep up with the loads coming in. Optimum total machinery packing weight is equivalent to half the delivery rate to the silo, ie you need 20t of packing weight to cope with a forage delivery rate of 40t/h.

Do not over roll at the end of the day – maximum 30 minutes. If filling over more than one day sheet the clamp and do not start rolling again in the morning until the first fresh layer has been placed on top.

- **Sealing.** With high DM crops, it is worth

Finishing off with a woven polyethylene mesh cover and gravel bags.



finishing off the clamp with a layer (minimum 75cm) of wetter forage to seal the surface better then ensure the surface of the clamp is reasonably smooth and cover with a double layer of standard 500 gauge (125mm) clamp sheeting. Allow at least 2m of overlap at joins and weight with touching tyres, bales or a heavy woven cover and some gravel bags. Alternatively, replace the sheet next to the forage with one of the new 'clingfilms'. These films are far more impermeable to air than standard sheets and suck down onto the surface of the clamp to provide an excellent airtight barrier.

- **Additives.** Although good clamp management is by far the best way to deal with aerobic spoilage, there are circumstances when a good additive can bring further benefits, but do not use it as a substitute for good management. If stability is likely to be an issue, perhaps because you cannot feed out fast enough, make sure you choose one that has been proven to improve aerobic stability.

Conventional silage inoculants based on *Lactobacillus plantarum* and designed to improve the fermentation will not usually do this as the main product of their homolactic fermentation is lactic acid which is not very effective against yeasts and moulds and can even be used by some of them as a substrate. A few of these inoculants have been shown to bring about animal performance benefits so good clamp management is particularly important to prevent potential higher DM losses from reducing that financial benefit.

However, some strains of *L. plantarum* have been shown to convert lactic acid to acetic acid when sugars are limiting and there is a limited supply of oxygen, a situation you would generally find some distance behind the face of an open clamp at feedout. As acetic acid is inhibitory to yeasts this can lead to improved aerobic stability.

Other inoculants, for example heterolactic *Lactobacillus buchneri*, carry out a secondary fermentation in the clamp, converting lactic acid into acetic acid and a number of other fermentation products that are inhibitory to yeasts. These silages are significantly more stable at feedout so, although fermentation DM losses will be increased, overall DM losses will be lower. Some initial concerns about high acetate levels reducing



An example of poor clamp management.

intake do not appear to be founded. Unlike other lactic acid bacteria inoculants, these are aimed solely at aerobic spoilage and have not been shown to bring about improvements in animal production.

Inoculants containing propionic acid bacteria have also been claimed to improve aerobic stability as they can, in theory, produce large amounts of both propionic and acetic acids from lactic acid and glucose. But these bacteria are slow growing and acid intolerant so do not usually survive long enough in silage to produce significant amounts of propionic acid.

Another approach is to use a chemical preservative, usually based on sulphites or organic acids such as sorbate, propionate or benzoate. These can be very effective, provided they are applied at a high enough rate, but are also aimed only at aerobic spoilage. It is the undissociated acid molecule that inhibits so their effectiveness increases as the pH falls during fermentation. A few additives combine the benefits of a conventional inoculant for improving fermentation and animal performance with a chemical preservative for improved aerobic stability.

Finally, salt can be forked into the top few inches of the clamp to reduce moulding in this vulnerable area. Apply at 3kg/m² (double on the shoulders).

Clamps – feedout

Most aerobic losses will occur at feedout, either at the silage face or in the trough. Opening the clamp allows micro-organisms that have remained dormant in the absence of oxygen to become active again. It is impossible to avoid exposure to air but there are several steps that can be taken to minimise DM losses.

- **Rapid feedout rate.** The amount of spoilage is directly related to the area exposed and the rate of removal. In winter move the face back by 1m a week, double that in summer – easier with a narrow clamp. Note, in a typical well consolidated grass silage, air may penetrate 1m behind the face so even if you are moving it back 1m a week all the silage would be exposed to air for seven days.

- **Keep the face tight.** Preventing air ingress deep into the bulk of the clamp is vital. An untidy, loose face will allow air to penetrate much further, lengthening the time of exposure. Using a sharp block cutter or shear

grab will make a big difference and is a very worthwhile investment. Aim for a flat, tight face, ideally cutting slightly overlapping blocks so as not to leave tufts where spoilage can start and infect the adjoining mass. Work the entire face in successive layers.

Facers are another option, whether they be attached to a loader or teleporter, free standing or on a self-loading feeder. They remove silage from the face using a powered rotor, leaving a very tight and tidy face and are designed to take a fairly shallow layer off the whole face.

They are particularly effective with maize or wholecrop cereals which tend to be very crumbly and difficult to keep tidy, even with block cutters. They are commonly used in many parts of the world but have not as yet caught on in the UK.

If a fore-end loader must be used, minimise damage to the face by loosening silage with a downwards motion rather than creating holes by lifting layers of silage. A loose face can more than double losses.

Always clear up any loosened silage that has fallen to the base of the clamp face. It will begin to spoil very quickly and mould spores will blow onto the face, encouraging spoilage.

Although it is sometimes suggested that spraying 10% propionic acid onto the clamp face would help prevent heating, in most cases it is likely to cost more than it would save.



A 'facers' leaves a very tight, clean face.

Being volatile it would need to be applied every day and it cannot penetrate far into the clamp to tackle the root of the problem.

- **Clamp sheeting.** Only roll the top sheet back as far as required and weigh down the forward edge to prevent air getting back along the surface.

Contrary to popular opinion, the clamp sheeting should never be pulled down over the face. This will not prevent air access; all it does is create humid 'greenhouse' conditions at the face – ideal for fungal growth. If birds are a problem, use a net.

Check the sheeting frequently for damage and repair immediately. Discourage vermin and birds with bait or scarers (a model owl or bird-of-prey often works).

- **Feeding Total Mixed Rations (TMR).** The aerating action of the mixer wagon makes things worse so reduce mixing time and mix

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smaller loads more often, especially if the silage is already known to be unstable. There are several TMR additives available but it is easier to tackle the problem in the clamp rather than in the mixer wagon.

● **Feed troughs.** Always remove uneaten material before adding fresh and avoid adding material that is obviously already heating and spoiling.

Bales

● **Rapid wilt.** Bales should not be made with forage at less than 30% DM. For grass, wilt rapidly to achieve this within 24 hours.

● **Chop.** Most round balers now chop which increases bale density, although the chop length is longer than with a forage harvester.

● **Bale shape.** Make even bales, especially if from chopped forage. Balers now use netting which helps maintain their shape better

Table 1. Recommended minimum number of layers of bale wrap.

Bale type	Min. layers
Round <40% DM	4
Round 40-50% DM	6
Square <50% DM	6
>50% DM or stalky	8

and is also more likely to stop sharp stalks poking through the wrap.

● **Wrap.** No plastic is 100% airtight and permeability increases if the plastic heats up in the sun but there are a number of things that can maximise its effectiveness. Wrap as soon as possible with a minimum of four layers and 50% overlap (Table 1). If baling stalky crops, for example wholecrop cereals, six layers will help prevent the stalks piercing the wrap. Using six rather than four layers can save 10-15% in losses, more than paying for itself. Use good quality wrap and pre-stretch for a better cling but do not overdo it. Wider wrap (750mm) reduces air leakage between layers. White or pale green/blue wrap will reflect the sun's rays better, reducing heating at the bale surface and internally. White is almost twice as effective as black.

● **Handling.** Never spike a wrapped bale – use a gentle squeeze to move it. To minimise the chance of damaging the wrap, wrap at the site of storage rather than in the field. Never drop wrapped bales onto sharp stubble. The latest in-line balers allow faster wrapping but do mean more handling.

● **Storage.** Maintaining the shape of round bales will prevent potential air leaks between the layers of wrap so do not stack too high (Table 2). Stacking round bales in one or two layers on their ends gives added protection due to the extra numbers of layers there but they must be solid bales with

%DM	Layers
>35	3 or 4
25-35	2
<25	1

Table 2. Maximum number of layers for stacking round bales on their sides.

flat ends. Square bales can be stacked overlapping in four layers or more provided the stack is stable. Do not leave wrapped bales in the field where they may attract birds. To prevent bird/vermin problems during storage net the stack (over tyres) and bait. Make sure stock cannot access. Check the stack regularly for bales with damaged wrap and repair immediately – feed these bales first.

● **Feeding.** Well fermented, untreated bales should usually be used within 48 hours of unwrapping but an additive proven to improve aerobic stability may extend this period significantly. Poorly fermented bales will usually be more stable.

Conclusion

No one factor is responsible for aerobic deterioration, nor is there a single solution. Careful consideration of all of the influencing factors and attention to detail can reduce the DM losses significantly, but they will never be eliminated completely. ■