What we need to do to lift feed conversion efficiency

Producers are constantly striving to get the maximum production out of any given feed intake, but just how do you do that? **Ann Hardy** reports on the latest thinking.

More milk from less feed. It sounds a simple enough promise but one that is hard to imagine can realistically be delivered.

However Keenan nutritionists are certain it can be, so much so they are hailing their Mech-fiber concept as a 'seismic shift' in cattle nutrition and claim it will typically bring a 20 to 30 per cent improvement in feed conversion efficiency* (FCE).

This is a substantial figure and one which they say can readily deliver extra margins worth 67p/cow/day when compared to exactly the same Total Mixed Ration produced in a more traditional way. And in many situations, it is believed these improvements can be exceeded.

The mechanism behind this success is complex but essentially boils down to a combination of creating the right physical structure to the ration and feeding it consistently, such that every mouthful the cow receives is exactly the same as the last, day after day.

The resulting environment created in the rumen is both constant and favourable, ensuring digestion becomes more efficient and complete, rumen and general health are improved and feed is utilised far more efficiently – resulting in less wastage through manure and methane.

The mechanical mixing of ration becomes important in lifting FCE.


Prof David Beever: breakthrough.

The principle may not sound unlike that applied to any Total Mixed Ration, and as Prof Jim Drackley from the University of Illinois, who has been closely involved in understanding and trialling the concept, admits: "It was a surprise to me that a machine effect could be so pronounced.

"But seemingly subtle changes can lead to huge benefits in efficiency," he says, citing early observations in France which revealed an average 2.5 litres more milk per day from 1kg (dry matter) less feed, representing an improvement in FCE of 15 per cent – before the concept had even been fully developed.

"At the same time, research at the University of Illinois was showing considerable improvements in herd health in Keenan-fed dry cows," said Prof Drackley. "Key findings included more consistent intakes both before and after calving with less fluctuation in body condition, increased lactational persistency and less body fat accumulation in the liver."

Taking up the story, Prof David Beever, Keenan's international nutrition director, said: "For scientists, the over-bearing question was why were these effects happening?"

Setting up a study under Dr Chris Reynolds at Reading University in 2008, the team found that 1 litre more milk per day was produced alongside 45g and 0.06 per cent more protein when the same ration was mixed in the new mixer compared with a vertical auger mixer.

Fistulated cows revealed rumen conditions were more stable and the amount of time, during which they were considered to be too acidic, was reduced by 33 per cent.

As the trial progressed, it became increasingly apparent that the bulk-density of the ration, the uniformity of particle distribution and the physical structure of the fibre particles were having a profound effect on the physical consistency of the resulting rumen contents.

Equally important was the team's developing knowledge of how they could practically manipulate these factors on the farm by being far more precise about the order in which individual components were added to the mix and the amount and nature of mixing each component received.

It is at this point that Keenan reveal another new trick in the shape of PACE – a system said to make the Mech-fiber concept deliverable on farm. The acronym stands for Performance Acceleration and Control Enhancement and the system comprises some hardware (a redesigned weigh box attached to the feeder wagon); some software (clever algorithms which determine precise quantities, the order in which each ingredient should enter the mixing chamber and the number of revolutions to apply to each component of the ration); and feedback which involves the farmer sending back milk yields to Keenan who will return to the farmer FCEs with absolute precision.

All this takes place through a waterproof memory key which stores the details of the ration and communicates between the


Prof Jim Drackley: surprised machine effect could be so pronounced.

Costs and gains

Cost of the PACE system only
- £150 per month plus taxes (£4.93 per day)

For a 100-cow herd:
- Cost per cow per day: 4.9p
- Gain per cow per day: 30p

Full package costs for the Mech-fiber 340 wagon plus PACE

For a 200-cow herd
- Cost per cow per day: 11p
- Gain per cow per day: 67p

This price includes a trade-in for an existing wagon.

Order in which components are added becomes important.

Retro-fitting existing Keenan wagons

The PACE system can be retro fitted to post 2003 Keenan mixer wagons. They must have six paddle technology to deliver Mech-fiber rations.

PACE box: key to Mech-fibre.

company, the weigh box and the farm computer.

Alongside the development of PACE, the company has revised its range of wagons, which all now carry the Mech-fiber brand along with a six-paddle design (similar to that in the earlier Klassik range), and a number of enhancements which have increased its capacity and improved its tumbling action. These have been achieved principally through extending the mixing chamber into the chassis, reducing the diameter of the auger and improving the design of the knives. Combining this with a lower power requirement and an overall narrower design, the new range is also said to be both more fuel-efficient and more easily manoeuvred into tight spaces.

The feed which is delivered by the combination of PACE-fitted wagons is said to be fluffy and of uniform mix, with architecture resembling that of a bird's nest.

"We are paying a lot of attention to conserving the forage identity in its entirety," says Prof Beever.

Keen to point out that the principles of Mech-fiber can be applied to many ingredients, the company says it can usually adapt existing on-farm ingredients to the system, although additional components could be required to provide the required physical structure – or mechanical fibre.

According to Prof Drackley, the Mech-fiber system provides the answer to many of the questions that have baffled nutritionists for years.

"One of the biggest questions it answers is why the perfect ration on paper often fails to deliver the results expected on-farm when fed to the cows," he says. "Up until now this has been a mystery, but this is just one of the many issues Mech-fiber addresses."

"But there is still more work to do," adds Prof Beever. "Nothing like this has happened in the last 20 to 25 years."

**** Feed Conversion Efficiency (FCE) is measured as kg standardised milk per kg dry matter intake.***

Coopon Carse Farm case study shows margins up by £1.41 per cow/day

The first detailed large-scale commercial study of the Mech-fiber and PACE concepts took place at Coopon Carse Farm in south west Scotland, where the system took over from rations produced in a vertical tub mixer.

The study implemented the programme in three stages:

1. The Mech-fiber wagon alone using the existing ration.
2. The full Mech-fiber ration, in which the structural fibre was improved.
3. The additional introduction of PACE, adding precision mixing to stages one and two.

Hugh Kerr: immense benefits.

Within four weeks, stage one had produced increased milk and milk protein production from less feed. This resulted in improvements in margin worth 32p/cow/day.

Stage two led to more pronounced results, with 1.9kg DM/cow/day less feed consumed and 0.9 litres more milk/cow/day produced. With an additional 0.34 percent protein, the resulting increase in margin was worth £1.03 cow/day.

Stage three and the introduction of PACE lifted the total margin by a staggering £1.41/cow/day, resulting from a 19 percent improvement in FCE, which rose from 1.25 to 1.49 in just 24 weeks.

"We don't believe we have got to the end of the route yet," says Hugh Kerr, Keenan's nutrition manager. "The sky is the limit for feed efficiency."

In fact, rates of up to 1.7 are predicted as achievable by Keenan, compared with the UK national average today of around 1.1.

"And these results were achieved on a highly professional unit already achieving a high level of production efficiency with good nutritional standards," he says.

"If results like this can be achieved on such a unit, the potential benefits for dairy enterprises around the world are immense."

Coopon Carse cows showed a 19% improvement in FCE to 1.49.

The milking ration for the 10,700kg herd at Coopon Carse Farm comprises:
- 0.5kg straw
- 1kg molasses
- 7.5kg premix
- 4kg caustic wheat
- 4kg maize silage
- 8kg wet brewers grains
- 4kg fermented wholecrop wheat
- 15kg grass silage