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Landwards

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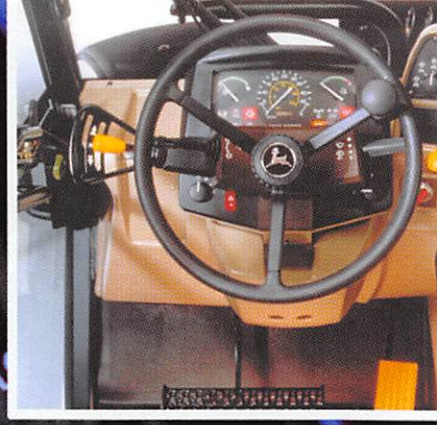
Agriculture • Forestry • Environment • Amenity

Annual Conference of the Institution of Agricultural Engineers
with Annual General Meeting Awards Ceremony
May 15th 2001, Silsoe Research Institute, Wrest Park, Silsoe



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[Inset Photo: JD 3000 Series telescopic handler]

Landwards

The Journal for Professional Engineers in Agriculture, Forestry, Environment and Amenity

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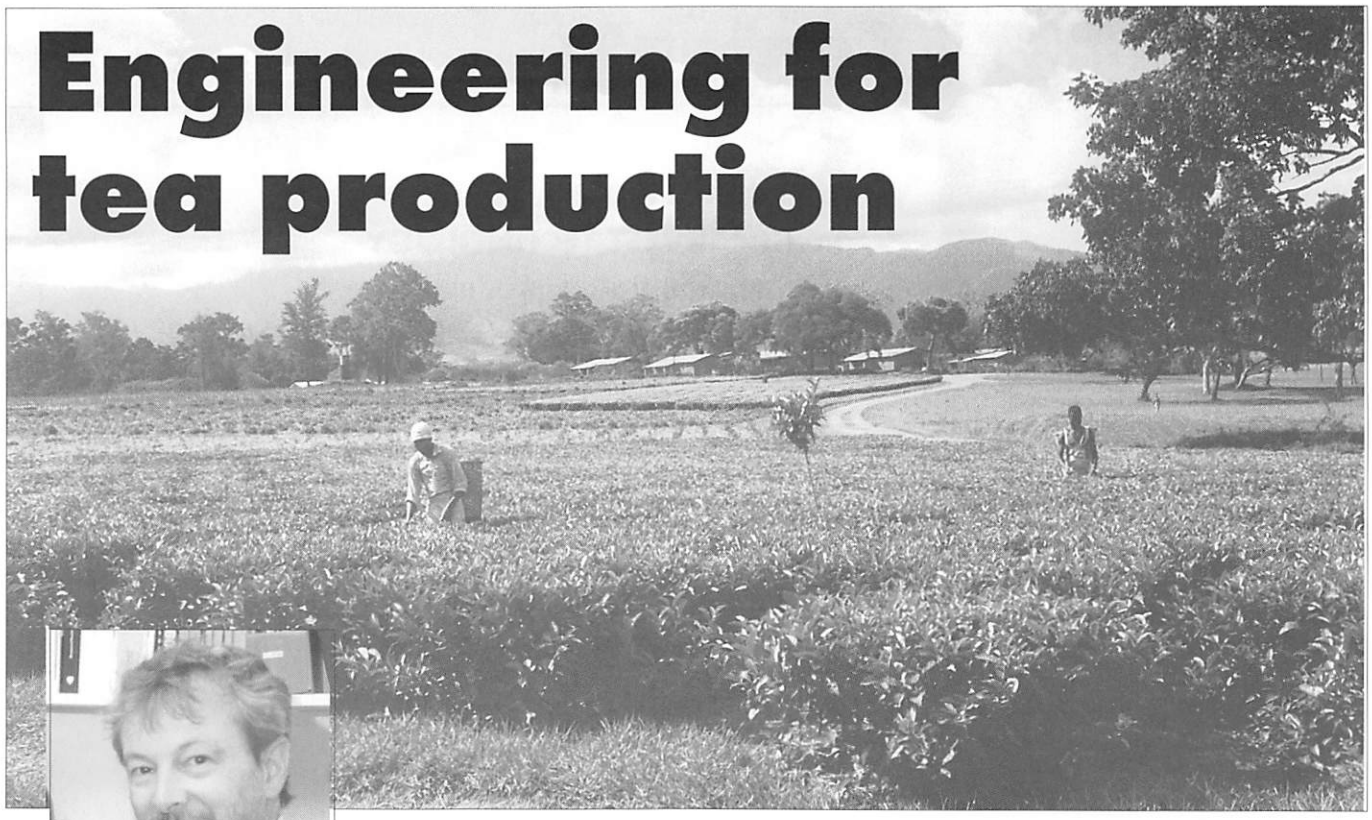
Engineering for tea production



Stephen J Temple

1. Introduction

Although some herbal products are marketed as 'tea', only teas manufactured from the shoots from the *Camellia sinensis* bush should really be sold as tea. *Camellia* was originally a plant of the jungle understory, in the region between Assam in India and China. It is now cultivated widely around the world, mainly in tropical and sub-tropical regions. In the Southern African region, the Tea Research Foundation (Central Africa) [TRF (CA)], based in Malawi, is responsible for research

Eur Ing Dr Stephen Temple FIAgrE spent 9 years as Research Engineer at the Tea Research Foundation (Central Africa), Malawi. He is now based in Norfolk.

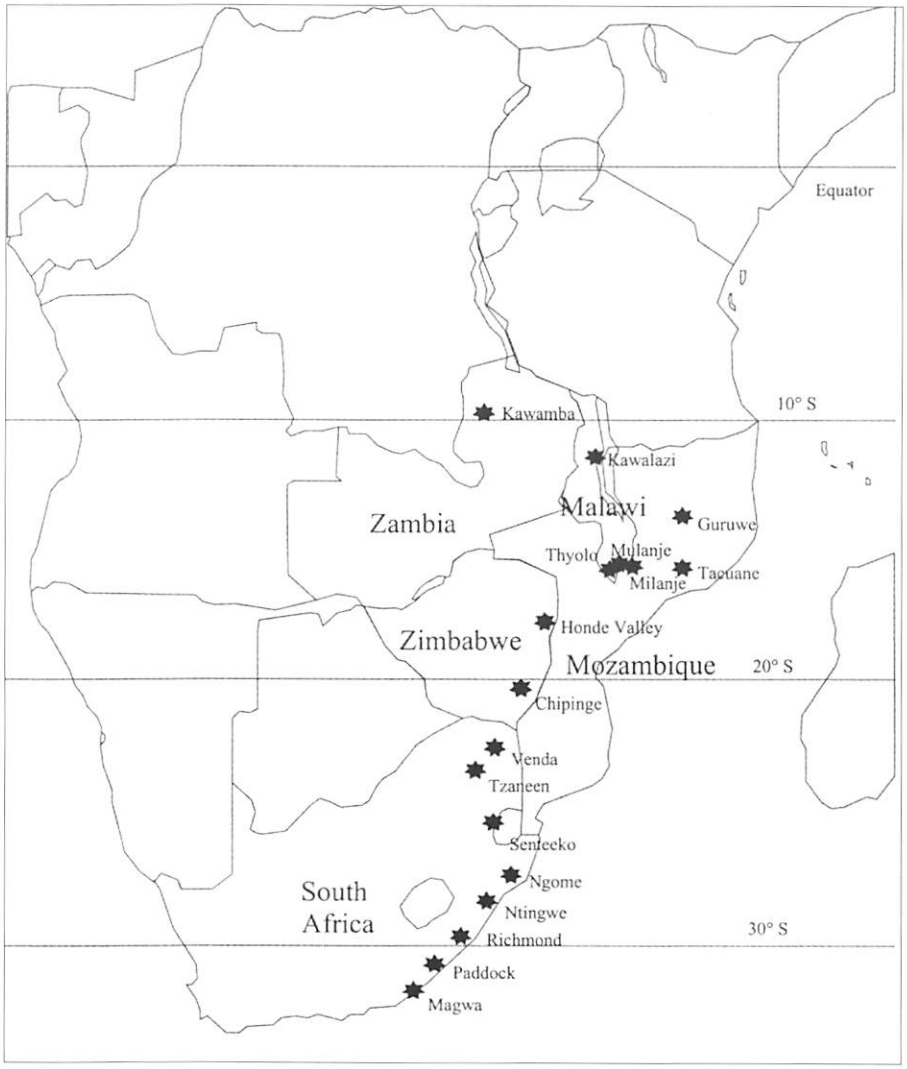


Fig.1 Tea growing areas in Southern Africa

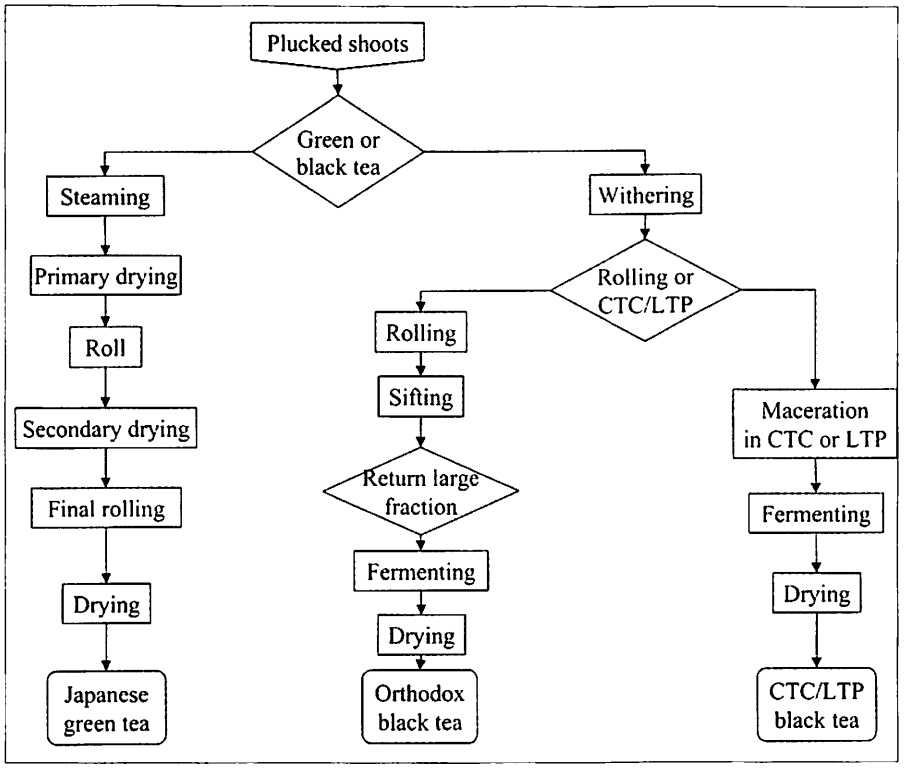


Fig. 2 Flow diagram for the manufacture of Japanese green tea, Orthodox and CTC (Cut, Tear and Curl) black teas

activities. The tea growing areas in the region covered by TRF (CA) is shown in *Fig. 1*. The tea growing areas normally receive some rain almost every month, unlike many areas in the region which have a dry season from April to November. The first tea bushes in Malawi were planted in the early 1890s, and the crop has developed since then.

2. Tea growing

Bushes were originally grown from seed, but almost all recent plantings are vegetatively propagated from specially selected source bushes. Such teas are known as clonal, because all bushes are genetically identical. A recent development is the commercial utilisation of grafted plants, using for a rootstock plants selected for vigour and drought resistance and for the scion a high quality and high yielding clone.

The cuttings are propagated in a nursery under shade, and planted out into prepared holes in the field at about 18 months old. Without irrigation, the bushes take 5 or more years to reach their maximum yield; irrigation can speed up the rate of development dramatically. The bush can produce new shoots almost indefinitely if managed properly; there are bushes almost 100 years old in Malawi; however, as newer clones with higher quality and greater yield become available, it is prudent to replace the older varieties once they are 30 to 50 years old.

3. Harvesting the crop

The harvested part of the tea bush is the young, growing shoot comprising two or three leaves and the apical bud. Once a shoot has been harvested by plucking, a new bud on the stalk starts to develop. During the main growing season in Malawi, the time from bud initiation to reaching a pluckable shoot is 42 days. This period is influenced by temperature and light conditions, so will vary in different parts of the world and at different altitudes.

Pluckers will return to the same bush every 7, 10/11 or 14 days to pluck shoots that have grown to a pluckable stage. This means there will be 6, 4 or 3 different generations of shoot on the bush at any one time, respectively.

As plucking proceeds through the season, the height of the 'plucking table' will increase with the growth of the stems. Every few years, pruning is carried out to bring this plucking table back down to a normal level, and to encourage the generation of new branches.

When the shoots are plucked, the moisture content is between 70% (in dry weather) up to over 80% in wet weather when the shoots are growing rapidly. In Malawi, yields of manufactured tea from one hectare can range from 1500 kg of dry, manufactured tea for seedling tea to 9000 kg for irrigated clonal tea.

In regions such as Kenya, where the tea is grown at high altitude with a well distributed annual rainfall, the crop yields hardly fluctuate from month to month. In Southern Africa the crop is grown at lower altitude where the rain is more seasonal and the temperature higher, there can be 90% of the annual yield produced in four months. Quality tends to be lower under low altitude, fast growing conditions.

The majority of the crop worldwide is plucked by hand, but mechanisation is gradually taking place. The Japanese have developed lightweight man-carried plucking machines, and there are various machines ranging from bicycle-wheel mounted to tracked developed in countries such as Australia, Argentina, South Africa and Zimbabwe. There has even been a machine developed in South Africa which travels on top of the crop, spreading its weight over large area tracks made from conveyor belting. Machine plucking cannot achieve the selectivity of hand plucking, so compromising quality. Some tea is grown on slopes which are almost impossible for machine work, and much of the crop is not planted in rows which are suitable for machine work, so manual plucking will feature for some time yet.

3.1 Research into tea

World-wide there are several organisations looking at tea including well known institutes in Japan, China, India, Sri Lanka, Kenya and Malawi. The majority of the research effort goes into fieldwork: agronomy, physiology and plant breeding. Partly because of the high cost of equipping a research processing facility and associated biochemical instrumentation, very little systematic work has been carried out into tea manufacture. Instead much of the processing work is carried out in commercial tea factories or in miniaturised processing units where full control of the conditions is difficult to achieve. The more sophisticated studies

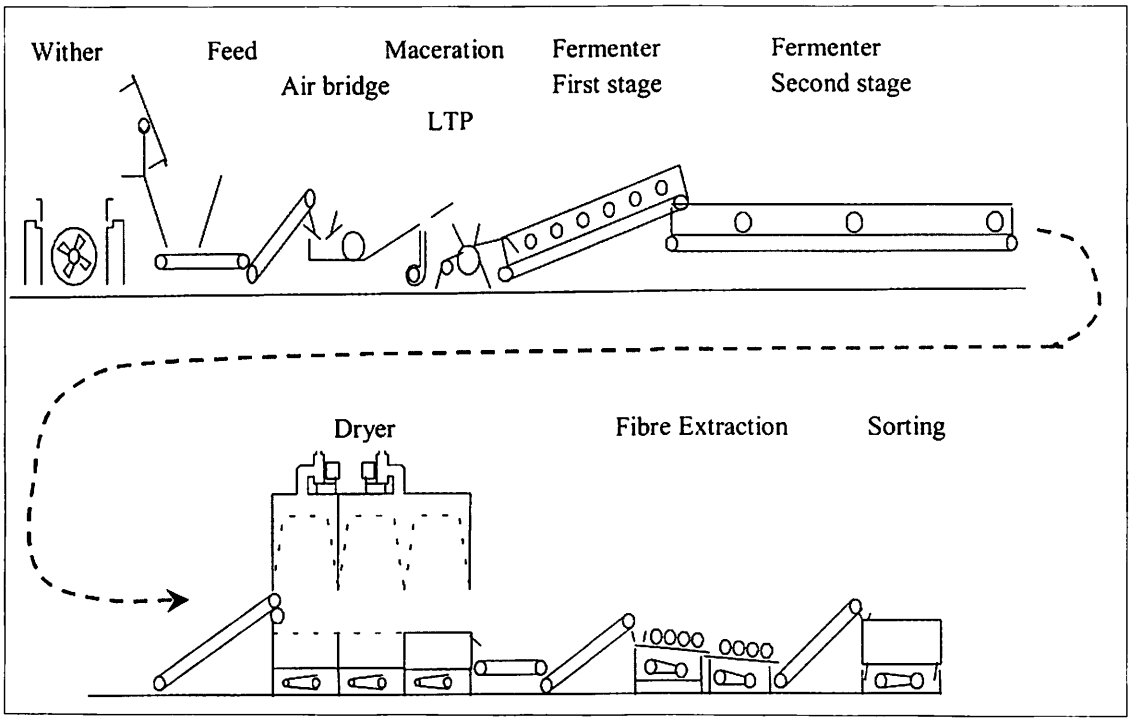


Fig. 3 Schematic diagram of LTP (Lawrie Tea Processor) black tea manufacturing process

into manufacture have concerned Orthodox and Green Teas, which concern whole leaf (see *Fig. 2*).

4. Tea manufacture – green and black teas

Tea can be processed in two main ways (*Fig. 2*). For green tea, enzymic action is killed off very early in the process using dry heat or steam but for black tea the enzymic oxidation is an important part of the process, termed by tea makers as 'fermentation' although it is nothing of the sort.

The majority of tea produced and drunk round the world is black tea; 2 028 000 tonnes of black tea and 582 000 tonnes of green tea were produced in 1996. All of Japan's production, 71% of China's, 75% of Vietnam's and 20% of Indonesia's production is green tea, which makes up 98% of world green tea. A flow chart showing the main processes in three types of tea is shown in *Fig. 2*. From this point on, all discussion refers to black tea only, and *Fig. 3* illustrates the sequence of machinery used in the manufacture of black tea.

5. Withering

After plucking, tea shoots are collected and taken to a factory for processing; it is important that minimal damage occurs to the shoots at this stage from heat or mechanical handling, as this can affect the quality of the final product.

On arrival at the tea factory, the shoots are spread out in layers generally no more than 300 mm thick, so that air can be blown through the leaf mass to stop the temperature rising from respiratory heating, and to reduce the moisture content. This process is termed withering. The target moisture content at the end of the withering phase will depend on the method of cell disruption to be employed, but will range from 72% down to 55% moisture content. During withering, which can take between 4 and 20 hours in normal circumstances, biochemical changes occur which can be advantageous to quality, although research findings are contradictory. When atmospheric conditions are suitable, ambient air is used for withering, moved through the shoots by axial fans. If the ambient humidity is so high that the rate of moisture loss is inadequate, the air is heated before being blown through the leaf; this is avoided whenever possible as the effects are deleterious to quality. The duration of withering will depend as much on the factory loading as anything else; it is often forgotten that withering is mainly a stockholding operation buffering the leaf supply from plucking which occurs in daylight only, to manufacturing which takes place for 23 hours per day in peak season. Some systems separate the stockholding and chemical change phase from the moisture removal phase. The "chemical wither" takes place in deep tanks, up to 2 metres in depth, with just enough ventilation to avoid self-heating of the shoots.

Withering is essentially a batch process, although attempts have been made to employ continuous withering machines. The batch nature of the process allows for different moisture contents of leaf arriving at random times during the day; it also allows for manufacture of similar types of leaf in sequence, even though their arrival at the factory is interspersed with other types of leaf.

6. Rolling or maceration

After withering, the shoots are rolled or macerated to break up the cell structure, releasing the enzyme systems to start the 'fermenting' process. Rolling is used in the 'Orthodox' method of tea manufacture, and results in whole leaf tea. To disrupt the cell membranes, a wither down to about 55% moisture is required before the rolling process. The alternative system involves cutting the leaf into particles of 1 mm or less in size, while totally disrupting the cell structure mechanically during the cutting process. The original method for this process was the Cut, Tear and Curl (CTC) machine, but in Southern Africa the Lawrie Tea Processor (LTP, derived from a hammer mill) is commonly used. In 1996, Asia produced 760 000 tonnes of CTC tea against 670 000 of Orthodox, while Africa produced 375 000 tonnes of CTC and LTP but only 8 000 of Orthodox tea.

7. Fermentation

After rolling or maceration has broken down the cellular structure of the leaf, the enzymic fermentation process starts. Air is introduced into the bulk of the dhool (as the macerated leaf is known) for cooling and to provide the oxygen

required for the various reactions taking place. Some of the more important reactions taking place at this time are the oxidation of catechins followed by condensation to form theaflavins and thearubigens. The dhool colour will change from green to brown as the reactions take place.

Depending on the enzyme activity level in the leaf, and the dhool temperature, the fermenting stage can take from 45 minutes to over two hours to reach the optimum quality level. If fermenting is too short, there may be unused catechins, or inadequate levels of thearubigens; if too long, then the desirable theaflavins are converted into thearubigens. Drying arrests fermenting; if the early stages of drying are slow then accelerated fermenting reactions deleterious to quality may take place.

The boiler and steam system is the most capital intensive and least fuel efficient, but it is easier to maintain a stable temperature. Control of temperatures in a boiler system is most often by manual observation of the boiler pressure gauge; occasionally a thermostatic modulating valve may be fitted to one of the radiators in a bank. As there is heat exchange between the flue gases and steam, then between the steam and air, there are more opportunities for inefficiency.

Stoves are mostly used with the older type of dryers requiring an inlet temperature around 100°C; the old cast iron types are now difficult to maintain and there is room in the market for the design of a new heat exchanger. These are intermediate in fuel efficiency between boilers and direct firing. As there is less thermal mass than in a boiler system, temperatures are less stable; control is manual, by observation of a hot air thermometer.

Both stoves and boilers are commonly fuelled by firewood, most often of *Eucalyptus spp.* grown on marginal areas of the tea estate. Very high yields of wood (up to 120 m³/ha per year mean annual increment) can be obtained in tea growing areas with high rainfall.

Direct firing (without any form of heat exchanger) using oil or gas is uncommon in Africa as these fuels are not locally produced and are therefore expensive relative to fuel wood. To use the exhaust gases from burning wood is liable to taint the tea unless very high temperature, efficient combustion is used. To ensure this occurs, the wood may be pyrolysed ('gasified') and the gases are then burnt to produce an exhaust gas at a very high temperature. To be usable for drying, cold air must be blended with this exhaust to give suitable inlet temperatures. The thermal mass in such a system is minimal, and without an automatic control system the temperature would be impossible to control. PID controllers are used to operate the combustion air dampers and the ambient to flue gas blending valves to obtain a stable temperature. As there are no flue losses with this system, the energy efficiency is highest.

To demonstrate the quantities of water to be removed and wood to be burnt, the schematic diagram *Fig. 4* illustrates that for every tonne of tea leaving the factory, approximately 9 tonnes of material enter the factory. The balance of 8 tonnes comprises water vapour and flue gas, all of which is carried away in the atmosphere. The electrical requirement is not shown here, but can form almost half the running costs of a tea factory.

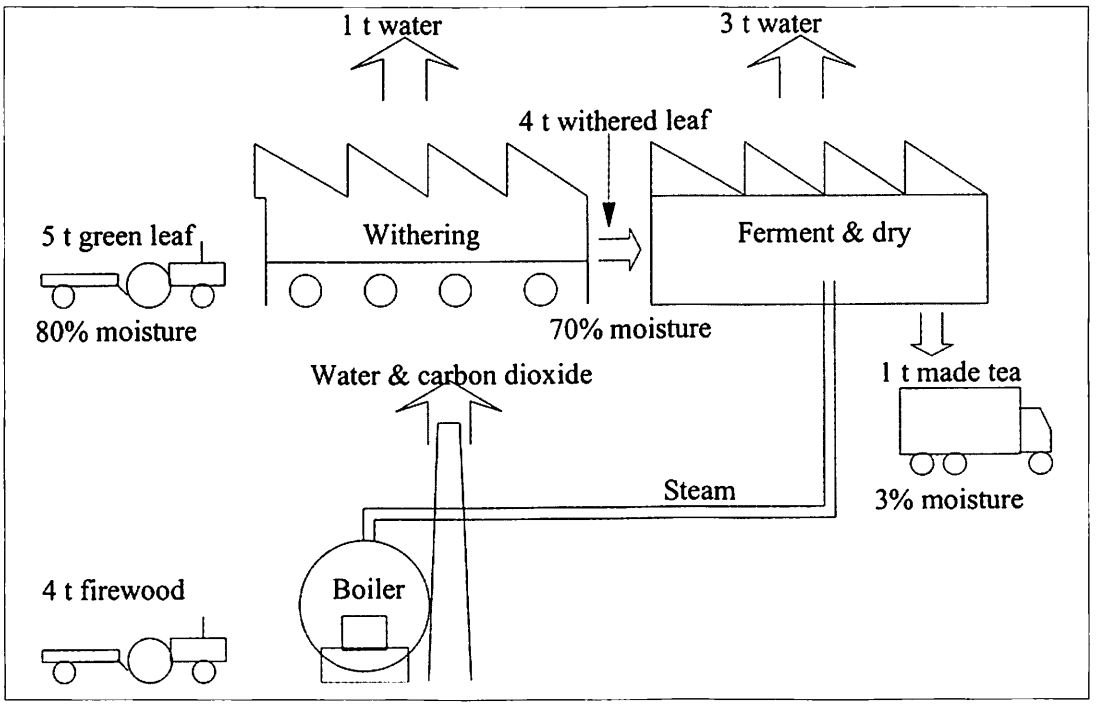


Fig. 4 Schematic diagram of mass flows in a tea factory

8. Drying - energy sources

Tea is universally dried by convective drying employing hot air; some experiments have been carried out with radio-frequency heating, vacuum drying and other techniques but hot air is the only practicable method on a commercial scale. The source of hot air may be from a flue gas to air heat exchanger ('stove'), from steam to air heat exchangers where the steam comes from a boiler fired on fuel-wood or coal, or from direct application of the products of combustion from oil, gas or gasified fuel-wood.

9. Drying

The dhool is fed into the dryer at around 71% moisture content wet basis, with a target final moisture of 3%. This means that every 100 kg of dhool fed in will produce about 30 kg of made tea. Chlorophyll breakdown and Maillard reactions due to the temperature in the dryer will result in the brown colour changing to black, which is desirable, but if allowed to proceed at too high a temperature will result in a 'bakey' or 'high fired' off flavour, detracting from quality. If there is excessive mechanical action rubbing the tea particles against one another or against the machinery, the leaf hairs which may contain some of the flavour chemicals will

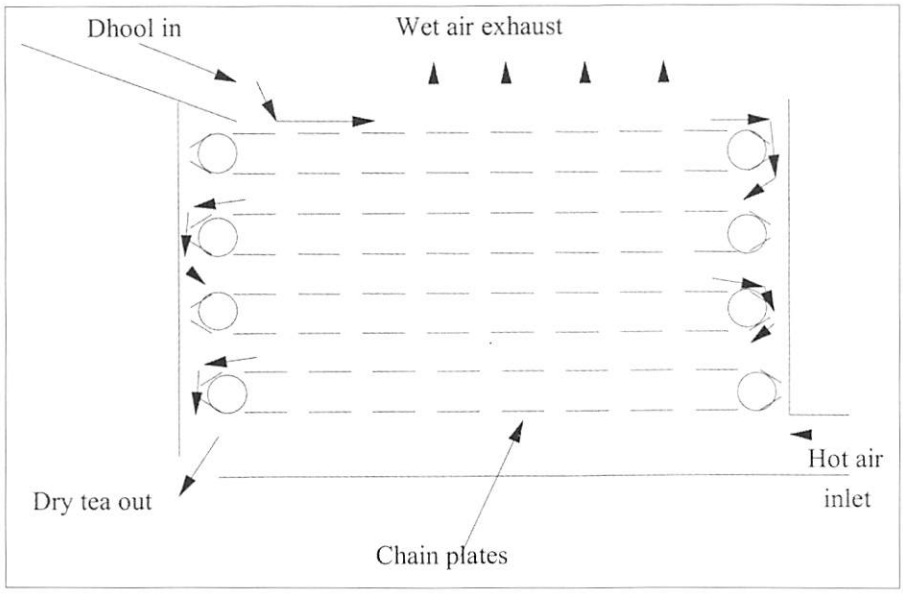


Fig. 5 Schematic diagram of ECP (Endless Chain Pressure) dryer

be knocked off the tea particles and lost with the exhaust air; this is known as loss of bloom.

There are two types of dryer in use in the tea industry; the first has been used since 1907 and is known as the ECP (Endless Chain Plate or Endless Chain Pressure) dryer. The second is the fluid bed dryer that was first developed for tea in Sri Lanka in 1974.

The ECP dryer (*Fig. 5*) consists of four or more conveyors made up of perforated metal trays attached to roller chains on either side. The dhool is fed into the top tray, and emerges from the bottom tray.

Effectively, this type of dryer is a combination of cross flow and countercurrent, with the driest tea meeting the hottest air. The exhaust air will be close to saturation, so the air is used very efficiently. There are three main drawbacks with this type of dryer; the inlet temperature is limited to the maximum that the dry tea can be exposed to without loss of quality. The air meeting the new dhool is almost saturated, so the drying rate at this point is low but the temperature is higher than used for fermenting; this can lead to unwanted reactions and loss of quality. Finally, the hot drying chamber contains moving parts that are in contact with the tea, cannot be lubricated and are difficult to maintain.

The fluid bed dryer is mechanically much simpler, in its basic form (*Fig. 6*) consisting of a perforated bed plate, through which hot air rises, surrounded by side plates which contain the drying material. The dhool is fed at one end; at the opposite end the side plate is lower than all the others and acts as a weir. When the tea level is higher than the weir it will flow out over the weir.

As the air flow rate through the bed fluidizes the particles in the bed, the material will find its own level and material fed in at one end will cause material to be discharged at the opposite end. It is essentially a cross flow type of dryer, with the same hot air meeting all the material in the dryer.

At the wet end, drying will be rapid and the air use efficient, leading to a saturated exhaust. Evaporative cooling keeps the tea particles at a low temperature, avoiding quality loss. At the dry end, because the drying rate is limited, the air will pick up little moisture and will not be used very efficiently. Improvements on the basic dryer include having two or more separate air supplies, generally with hotter air at the feed end where drying can be more rapid and cooler air at the dry end where loss of quality can occur. To improve the efficiency of air use, the exhaust air from the dry end, which is far from saturation, can be recycled through the heater units once any light particles have been removed.

The fluid bed dryer looks a very simple machine, but because the material being dried is changing in density and moisture content as it passes through the dryer, its speed and drying rate will be very difficult to estimate. It is suspected that the time taken from making a change in conditions to reaching a stable operating point is at least 20 minutes, making manual control difficult.

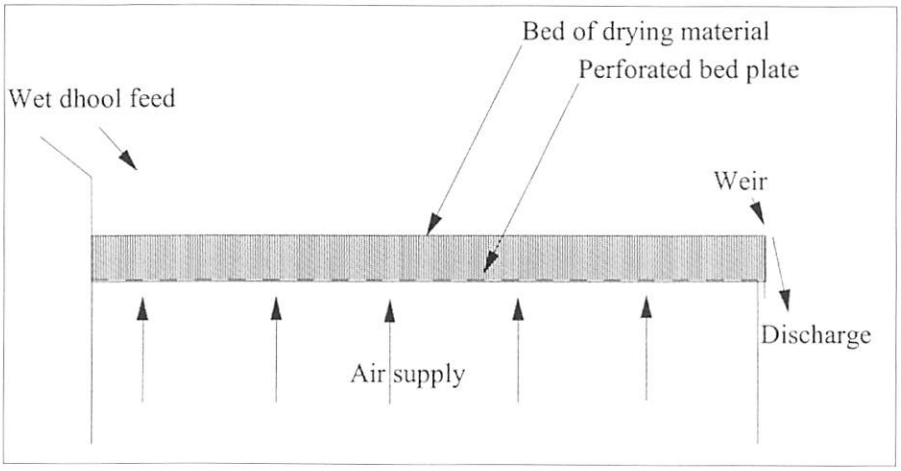


Fig. 6 Basic fluid bed dryer

10. Sorting, storage and packing

After drying, the fibrous particles from the stalk and leaf midrib are separated from the black tea particles by electrostatically charged rollers. This process works best when the relative humidity is very low and the tea is hot and dry, so is carried out immediately after drying. Vibrating or oscillating screens are used to sort the black tea particles into various size grades.

To consolidate a batch of a single grade of tea for sale, the sorted teas are stored in bins where the moisture absorption will be less than if exposed to the atmosphere. Once enough tea has accumulated to pack a batch, it is loaded into multi-wall aluminium foil lined paper sacks ready for sale and dispatch.

11. Qualities of teas

Flavour or character of tea arises from volatile aldehydes, which are mainly formed from fatty acids and chlorophyll breakdown products throughout the process. Some of these compounds are desirable, others detract from the value. They are more prominent in high grown teas, and are not important in Southern African teas at present.

The actual colour of the tea liquor without and after adding milk is assessed as a quality parameter. Different colours are required for blending. Brightness is an aspect of colour which is assessed separately, the opposite of which is termed dull. A dull liquor can arise from excessive fermenting or a slow start to drying. Thearubigens contribute a large part of the colour of tea liquors.

Briskness is a mouth-feel characteristic of tea, mainly dependent on theaflavin content.

Although the purchaser of teabags does not see the colour of the black tea, tea buyers require a black rather than a brown colour. Contributions from chlorophyll breakdown products, gallic acid and Maillard reaction products form the black colour.

Particle size and packing density are important parameters in terms of how well tea bag packing machinery can handle the product. If it cannot be filled into teabags rapidly and takes up too much space in the bag, it cannot be used for this purpose and looses value accordingly. Particle size is determined partly by the cutting process, and together with density, by the amount of shrinkage in subsequent processes. Withering can affect density by shrinkage before cutting.

Bloom is assessed by inspection of the dry black tea. If the leaf hairs, or the dried products of fermentation, have been knocked off the tea particles by excessive mechanical handling when dry, the tea will look grey rather than black.

12. Concluding remarks

Despite the development of tea processing over at least two centuries, much of the process has been developed by factory engineers using trial and error while attempting to maintain commercial outputs. There has been significant fundamental and applied biochemistry research, but very little good engineering work has been published.

At present, a tea factory sells the teas it happens to produce, all the time striving for quality. The objective for the future must be to produce tea to order: perhaps a coloury tea one day for blending, and a bright, brisk flavoury tea the next. The developers of the LTP distinguished between 'sergeant major' tea and 'drawing room' tea, descriptions which just about say it all.

Further reading

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Willson K C; Clifford M N (eds) (1992). Tea: Cultivation to Consumption. Chapman and Hall, London

A winning combination from Vredestein

Vredestein brought an outstanding combination to the Smithfield Show with two award winning products that demonstrated excellence in the tractor and implement tyre sectors.

Vredestein's Flotation Plus, an implement tyre with innovative qualities, was endorsed by the award of a Royal Agricultural Society of England (RASE) Silver medal for excellence in agricultural machinery in 1996.

To add to that success Vredestein, has this year won another award, for Traxion + which has been awarded a merit by RASE. This high-tech tractor tyre gives outstanding performance in both field and transport work and was the only tyre to win an award in the Machinery Award category which is given to products that make a real difference in terms of quality of work.

Ian Wilson, Vredestein's UK Director and General Manager, comments: 'We believe having an award winning tractor tyre and an award winning implement tyre puts Vredestein in a unique position. After all if you've fitted a great tractor tyre, you want an equally good implement tyre to go with it.

Flotation Pro

The Flotation Pro is an advanced radial tyre that meets the needs of farmers and contractors, performing well both on the land and the road. The most striking element of the Flotation Pro is the radial structure of its flexible carcass, with a sturdy belt under the tread. This ensures that pressure is evenly distributed over the contact area providing the tyre's balanced performance on the land. On the road, the radial construction reduces heat generation in the carcass, facilitating transport at higher speeds.

What's more, the Flotation Pro has a number of additional benefits giving reductions in fuel consumption, high driving comfort levels and less 'down' time due to tyre problems.

Implement AS

The new Vredestein Implement AS agricultural tyre meets the need for a multifunctional implement tyre which can cope with the huge variety of tasks carried out by farmers today.

Originally developed to meet the demands of manufacturers of trailed mowers, the Implement AS is an implement tyre with a traction profile that rolls through grass without drifting. This not only keeps mowing efficient, but also prevents the grass being damaged by the tyres sliding across it.

The tyre can be used on other non-driven axles such as sowing machines and driven axles such as compact wheel loaders. Its use on self-drive compact tractors has shown that the Implement AS is at home doing horticultural as well as agricultural work.

Government sets targets to cut work-related deaths, accidents and illness in biggest health and safety shake-up for 25 years

For the first time ever, the Government and Health and Safety Commission (HSC) has announced targets for the nation to reduce work-related deaths, ill-health and injury in Great Britain. Accidents and ill-health among the work force cost the British economy up to £18 billion a year.

The specific targets are to:

- reduce the number of working days lost from work-related injury and ill-health by 30 per cent by the year 2010 (a decrease of 7.5 million working days on current estimates);
- reduce the incidence of people suffering from work-related ill-health by 20 per cent by the year 2010 (80,000 fewer new cases on current estimates);
- reduce the rate of fatal and major injury accidents by 10 per cent by the year 2010 (3,000 fewer cases on current figures);
- achieve half of each improvement by the year 2004.

To do this the Government and HSC have introduced a ten-point strategy supported by a 44-point action plan which will provide incentives and practical support to employers, together with a range of measures to tackle employers who do not meet their health and safety responsibilities.

The strategy highlights that the health and safety system must promote a better working environment as well as prevent harm. It also: focuses on occupational health as a priority; the need to motivate all employers, particularly small firms, to improve their health and safety performance; the need for Government to lead by example; the importance of education at all levels for improving health and safety and the role of effective design in preventing risk.

The Action Plan will include:

- an **occupational health strategy** to combat the many work-related illnesses which occur in the modern workplace. This will promote best practice and look at ways of helping people to return to work after an illness;
- **tougher penalties** to deter health and safety offences, including: imprisonment to be available for most health and safety crimes; and the increased maximum fine available in the lower court - £20,000 - to be extended to most health and safety offences;
- **an examination of new innovative penalties** such as fines linked to turnover, prohibition of bonuses and suspension of managers without pay;
- **a director's code of practice,** which will make a named person responsible for health and safety matters within every company;
- **new help for small businesses,** including: piloting a health and safety grant; providing better targeted support through the Small Business Service; and the provision of comprehensive - including sector-specific - health and safety guidance for small firms;
- **abolition of Crown Immunity** as part of a package of major reforms to improve health and safety performance and accountability in the public sector; and
- explore with the insurance industry **incentives** to reward good health and safety performers at the expense of those companies with poor health and safety records.

In addition, the action plan will include: a new one-stop call centre for employers to report accidents to the HSE; a 'ready reckoner' to help business identify how much money they can save by improving their health and safety record; and a legislative database for on-line guidance on health and safety legislation.

Success will depend on effective partnerships between the various stakeholders - employers, employees and their representatives - and in particular developing the role of safety representatives in the work place.

Commenting on the targets, HSC Chairman Bill Callaghan, said: 'Health and safety at work should be a core requirement of business activity, not an inconvenient 'add-on'. As far as I am concerned, those who cannot manage health and safety, cannot manage. We need to create a positive health and safety culture which sees business go beyond doing the statutory minimum.

'Government, employers and workers need to move forward together in order to meet the challenges of the future. I want to see a revitalised health and safety system as relevant to the call centre as it is to the construction site'

Mr Callaghan explained: 'The HSC, HSE and local authorities will do all they can to help improve health and safety at work. However, I will be looking for top-level commitment from employers, unions and others to agree and set targets for their own sectors and firms.

'In particular, I would like to see an increasing role for safety representatives. As well as contributing significantly to improving health and safety, they also encourage the kind of partnership approach we are looking for.'

Commenting on small firms, Mr Callaghan said: 'I appreciate the specific difficulties that small firms face, which is why the action plan includes a comprehensive range of measures to help them.'

Mr Callaghan concluded by warning

that he would have no sympathy for employers who choose to ignore their health and safety responsibilities:

'Work-related illness and injury cost this country up to £18 billion a year, while the cost in terms of human suffering cannot be measured. Unfortunately, it is the victims themselves, their families and the taxpayer who bear much of this burden. I will be giving the Government every encouragement to introduce measures which crack down hard on offending employers'.

Deputy Prime Minister, John Prescott, said: 'I want businesses to raise their game and Bill Callaghan and I are writing to stakeholders in the health and safety business with a strong message - that they must never ignore their responsibilities and the rights of their workers. Health and safety is a priority issue for those at the top of all organisations and they must be prepared to face the consequences of ignoring the law; in future that could well mean prison.'

Copies of *Revitalising Health and Safety Strategy Statement* are available from DETR.

Contact: **DETR Free Literature, PO Box 236, Wetherby, West Yorkshire LS23 7NB. Tel: 0870 1226236 or Fax: 0870 1226237**

Look before you leap

Around over half of all UK Farming companies will not be able to afford next year's salary increases. That's the claim from the latest Plimsoll Portfolio Analysis: Farming, Autumn Edition, 2000.

Plimsoll's latest analysis studied industry salaries against a company's ability to pay. They found 216 companies that if faced with rising costs, set against zero sales growth, are heading for problems. The implications are serious and companies must question whether they can allow this to happen.

The analysis predicts that average salaries are likely to rise to £18,600 up from £17,800 next year, a 4.4% rise. This may sound like good news to some but the warning is clear, if you are considering changing jobs or reviewing your options take a good look before you leap.

These troubled 216 companies have several problems to be dealing with if they are to get on track and against the other 173 companies in the industry that were analysed, many of these lagging companies measured quite poorly.

Perhaps the most crucial problem for these lagging 216 companies is their inability to generate a good sales per employee figure. With a dismal £56,800 sales per employee figure, they are nowhere near the stronger 173 companies which achieve on average around £98,900 per person.

Salary expectations	Facing losses if adopting salary predictions	Able to afford next year's salary rises	Industry average
Sales per employee	£56,800	£98,900	£73,200
Average salary	£14,300	£19,000	£16,300
Salary % of sales	25%	22%	23%
Average pre-tax profit margin	-6.2%	9.5%	1.4%
No. of companies analysed	216	173	389

Adding to their troubles is the fact that these 216 companies also record below average salaries paying on average just over £14,300 per year, compared to the rest of the stronger companies with £19,000 on average.

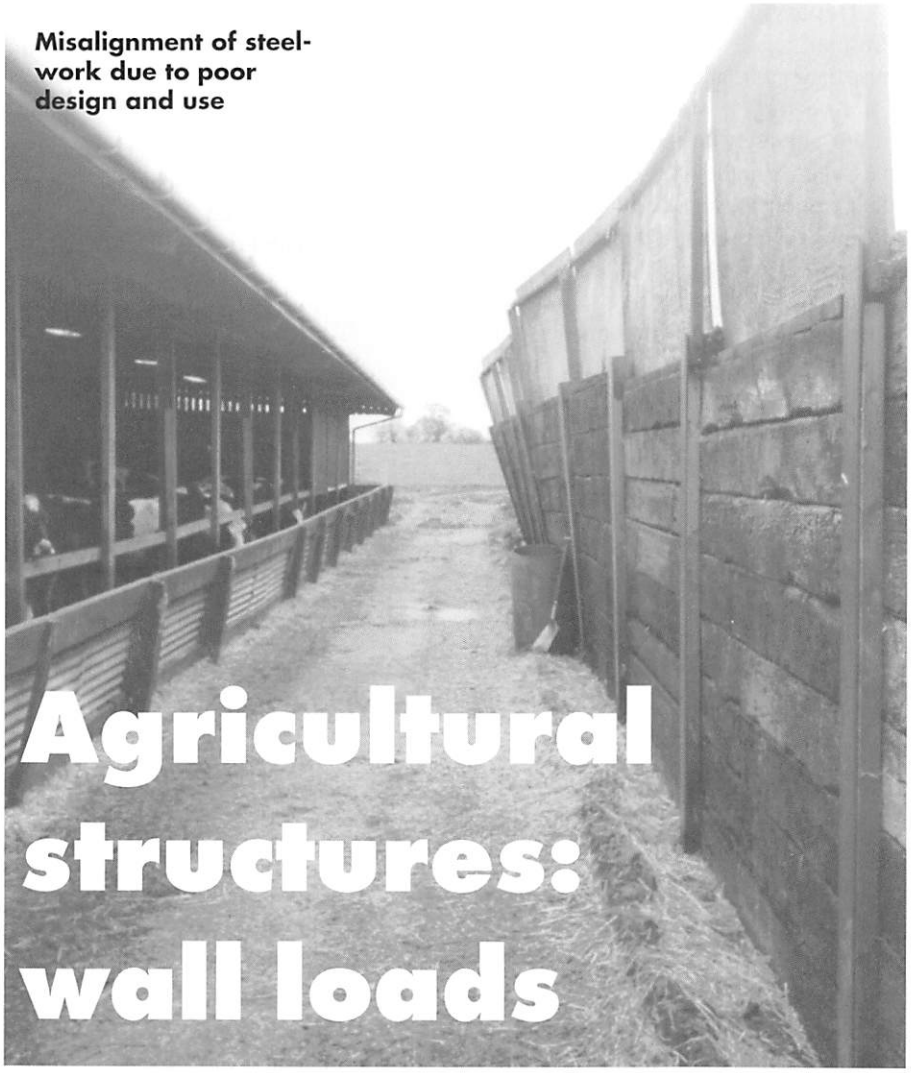
It is essential for any successful company to keep its spend on salaries in line with sales. Unfortunately there was strong evidence that these 216 companies had their salary bill completely out of line spending on average 25% of sales on salaries, with the stronger companies only spending 22% of sales on salaries on average.

These 216 companies do have some choices if they are to be a successful company next year. An acceptable business plan may be to set next year's costs in line with this year's sales taking on a zero percent sales growth for next year. This could be a credible scenario to adopt when currently 59% of the industry had zero growth in their latest performance.

So just how many companies in the Farming industry have got the balance right? Plimsoll has revealed that last year 11 companies within the industry managed to increase their number of employees and increase sales while managing to stay financially secure.

The *Plimsoll Portfolio Analysis: Farming, Autumn Edition 2000*, containing full details on 988 companies costs £305. *Mention this magazine when ordering and you will receive a 5% discount on the purchase price.* Or for a free download of the best 11 companies mentioned visit www.plimsoll.co.uk. These names will be posted on the internet September 1, 2000.

Contact: **Jennifer Ovington, Plimsoll Publishing Ltd, The Vangard Suite, Broadcasting House, Middlesborough TS1 5JA. Tel: 01642 257800**



Misalignment of steelwork due to poor design and use

Agricultural structures: wall loads

Richard W Langley

1. Introduction

There are many farmers who erect new (or secondhand) walls and use them to retain materials such as grain, potatoes or silage. The subsequent loading put onto these walls can be immense, especially if the material is wet or piled up higher than it ideally should be. If a wall was happily supporting grain one minute and then found itself holding up silage the next, does it matter too much? No doubt the steel or timber will still do the job adequately, and even if the wall groans, creaks or moves a little, it will remain standing. Structures that fail always give plenty of warning - don't they?

In this article, the basic forces present on walls used to store grain and silage are looked at. Using an example specification for a wall of typical construction, some important differences are highlighted.

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Wall construction - an example

Let us take a 3 m high wall, constructed of universal beam stanchions (*i.e.* RSJs) with ex-railway sleepers or precast concrete panels slotted between them. The horizontal distance (centre to centre) between stanchions is 2.58 m. This wall acts as a cantilever, which can be defined simply as a beam supported only at one end. Any loading put against this cantilever must be resisted by the universal beam itself and its support at the base. The beam could shear or it could bend, as shown in *Fig. 1*. We will assume that each stanchion is concreted into adequate (possibly also reinforced) footings (*i.e.* not just bolted down), and that the beam is unlikely to fail in shear. Hence we are only looking at possible failure due to bending. (Analysis of the footings is another important issue affecting the overall strength and stability of the wall, but will not be considered in this article).

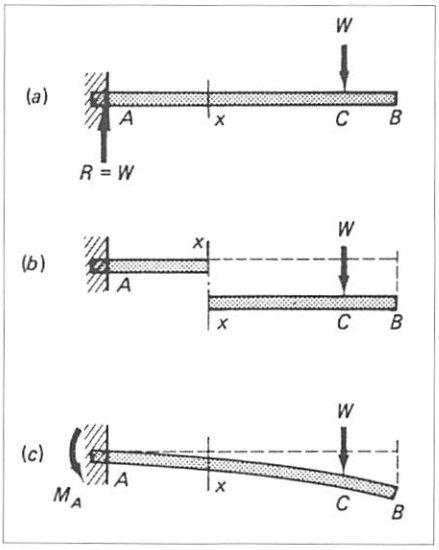


Fig. 1. Cantilever beam AB, carrying a load W at point C; (a) resultant supporting load R; (b) shear force at point X; and (c) bending moment M_A at the beam support A

Forces on storage walls

There are four forces which are discussed for grain storage and silage storage, respectively. These are the forces of thrust, bending moment, elastic modulus and deflection.

2. Grain walls

Thrust

This may be calculated from Rankine's theory:

$$P_a = \frac{p \times g \times h \times (1 - \sin \varphi)}{1 + \sin \varphi} \quad (1)$$

where P_a is lateral pressure in N/m^2, φ is angle of repose of grain (same as the angle of shearing resistance when dealing with a perfectly dry uniform soil), p is density of grain in kg/m^3, g is the gravi-

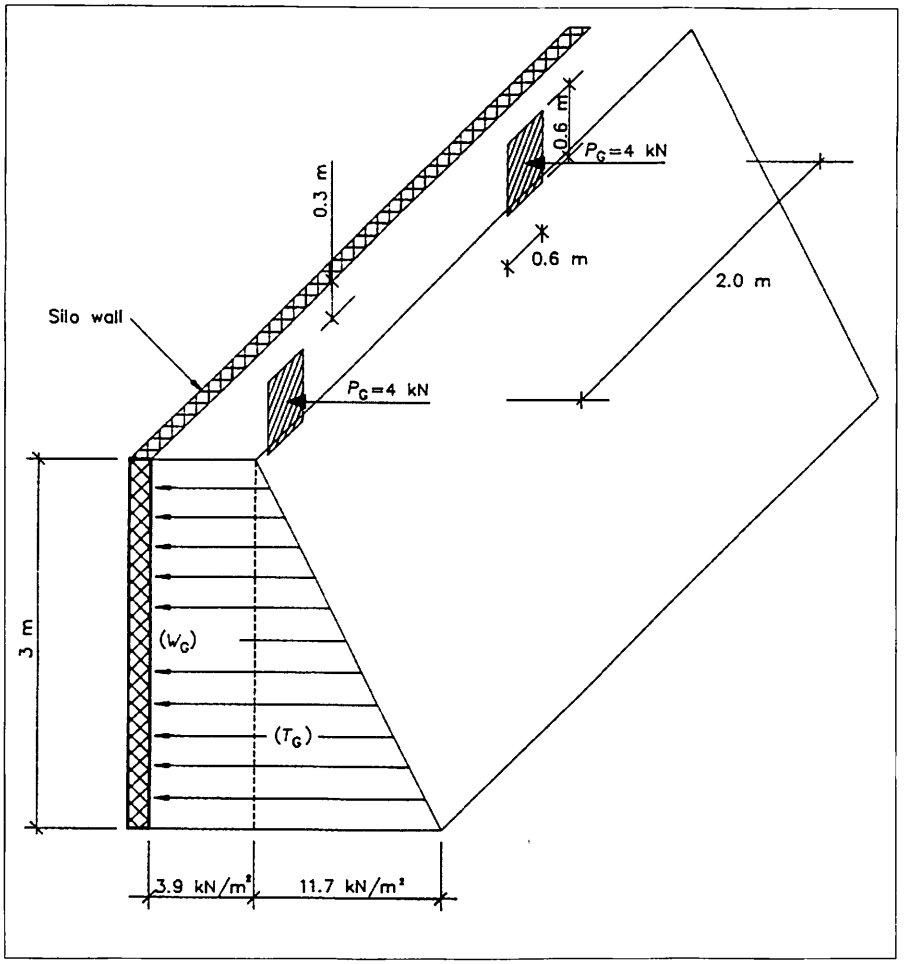


Fig. 2. Loads on a silage retaining wall for a drained silo with a consolidating vehicle not exceeding 8 tonnes gross weight; W_G, side loading from the component of lateral pressure which is uniformly distributed; T_G, side loading from the component of lateral pressure which increases linearly with depth; P_G, concentrated side loading caused by each wheel of the consolidating vehicle

tational acceleration in m/s², and h is height of storage in m.

If we take the grain to be wheat, having an angle of repose of 25°, and a density of 800 kg/m³, the lateral pressure is:

$$P_a = \frac{800 \times 9.81 \times 3 \times (1 - \sin 25)}{1 + \sin 25}$$

This gives a value for P_a of 9617 N/m². We can then find the lateral active thrust T_a using:

$$T_a = \tfrac{1}{2} \times P_a \times h \qquad (2)$$

which will act at a height of $h/3$ above ground level. Thus,

$$T_a = \tfrac{1}{2} \times 9617 \times 3$$

giving a value for the lateral active thrust of 14426 N/m or 14.4 kN/m (acting at 1 m above the floor). Now, since the spacing s between the stanchions is 2.58 m, the total load or thrust W is:

$$W = T_a \times s \qquad (3)$$

so,

$$W = 14.4 \times 2.58$$

The value of the total thrust is then 37 kN.

Bending moment

Once we know the total load or thrust, we can determine the bending moment M_b in kNm. This is given as simply:

$$M_b = W \times a \qquad (4)$$

where W is the total load in kN and a is distance in m from ground to the point at which it acts.

Thus,

$$M_b = 37 \times 1$$

The bending moment is then 37 kN.

Elastic modulus

In order to select an appropriate size of beam, we must use the following:

$$Z = \frac{M_r}{f} \qquad (5)$$

where Z is section or elastic modulus in cm³ and M_r is moment of resistance in kNm, which is greater than or equal to the maximum bending moment and f is the stress in N/m².

Let us assume the panels spanning between the cantilevers provide adequate lateral restraint (*i.e.* prevent the cantilevers from buckling sideways along their weak axis). We can assume a value for f of 165 N/mm², for universal beams in tensile bending, so:

$$Z = \frac{37 \times 10^3}{165}$$

This gives a value for the elastic modulus of 224 cm³.

Referring to tables of structural sections reproduced from BS 4: Part 1 and BS 4848: Part 4 (British Steel, 1996), it can be seen that a universal beam of 254 mm x 102 mm and 22 kg/m gives an elastic modulus of exactly 224 cm³ about the X-X axis. This should therefore be adequate for our grain wall loading situation.

Deflection

In agricultural situations, beam deflection D in cm is unlikely to be a major concern since there are no elaborate or expensive finishes to be damaged, especially true in this case. However, it is interesting to note the magnitude of beam deflection occurring, and it can readily be calculated from the formula:

$$D = \frac{WL^3}{15EI} \qquad (6)$$

where, W is load in kN, E is Young's Modulus of Elasticity (typically 21000 kN/cm² for steel), I is second moment of area about the X-X axis (which is 2841 cm⁴, taken from the structural sections tables for our chosen beam), and L is span in cm. Thus:

$$D = \frac{37 \times 300^3}{15 \times 21000 \times 2841}$$

Then, the deflection is 1.12 cm or 11.2 mm. This is quite a considerable deflection, but should not cause any problems with the walling.

3. Silage Walls

Reference to BS 5502: Part 22 (BSI, 1993) and Farm Waste Storage: guidelines for construction (Mason, 1992), gives general procedures for calculating the loads present on a silage wall.

Bending moment

Taking the same wall height and distance between stanchions (with maximum weight of tractor on the clamp of 8 tonnes), we can calculate the total bending moment. There are three separate loads to consider (*Fig. 2*). The uniformly distributed component of lateral pressure on the wall results in a side load W_G, whilst the component of lateral pressure

Table 1. Force applied on storage walls by grain and silage, respectively

Product stored	*Total thrust, kN*	*Max pressure at base of wall, kN/m²*	*Bending moment at base of wall, kNm*	*Universal beam (UB)*	
				Size, mm	*Weight, kg/m*
Grain	37	9.6	37	254 × 102	22
Silage	79.5	15.6*	100	305 × 127	48

* ignoring side thrust from wheels of consolidating vehicle
No allowance has been made for impacts from machinery, *etc.*

increasing linearly with depth results in a side load T_G. The wheels of the consolidating vehicle, when adjacent to the wall, generate two consolidated loads P_G of short duration acting horizontally on an area of 0.6 m by 0.6 m, with centres 0.6 m below the surface and 2 m apart along the wall.

(i) *Uniform side loading*
The component of lateral pressure which is uniformly distributed on the wall is 3.9 kN/m². If height is 3 m and the width of each section is 2.58 m, then the thrust W_G can be calculated for the area of each wall panel as:

$$W_G = 3.9 \times 3 \times 2.58 = 30.2 \text{ kN}$$

This will act at half the height *i.e.* 1.5 m. Thus, bending moment can be calculated by substituting values in Eqn (4):

$$30.2 \times 1.5 = \mathbf{45.3} \text{ kNm}$$

(ii) *Depth dependent side loading*
For the component of lateral pressure which increases uniformly with depth, the load or thrust is calculated as half the maximim pressure of 11.7 kN/m² at the base of the wall times the area of the wall panel, so:

$$T_G = \tfrac{1}{2} \times 11.7 \times 3 \times 2.58 = 45.3 \text{ kN}$$

This will act at 1/3 of the height from the base. Thus, the bending moment is calculated as:

$$45.3 \times 1 = \mathbf{45.3} \text{ kNm}$$

(iii) *Concentrated wheel load*
Assume each stanchion must take the side load P_G of 4 kN resulting from one of the wheel of the consolidating vehicle and acting on the wall at a height of 2.4 m. Thus, the bending moment is:

$$P_G = 4 \times 2.4 = \mathbf{9.6} \text{ kNm}$$

Therefore the total bending moment for the silage wall is the summation of W_G, T_G and P_G giving **100.2** kNm.

It will be noticed that this figure is considerably higher than that for the grain wall. Likewise if the wall pressures are considered, then that exerted by the silage wall is much greater than that exerted by the grain wall.

Elastic modulus
Using the same equation as before, Eqn (5):

$$Z = \frac{100 \times 10^3}{165}$$

The value for the elastic modulus is 606 cm³.

Referring to the structural tables, an adequate section size and weight is 305 mm x 127 mm and 48 kg/m, which gives an elastic modulus of 616 cm³ about the X-X axis. (Other examples of beam sizes could equally be chosen to suit this situation *e.g.* 305 mm x 165 mm and 46 kg/m, or 356 mm x 127 mm and 39 kg/m).

4. Summary of results

Table 1 details a summary of results from the calculations made.

5. Conclusions

The above values illustrate clearly that wall loadings present on grain and silage structures are *very* different. That is, the thrust *etc.* is significantly higher for silage and it must therefore be emphasised strongly that grain walls are *unsuitable* for silage retention purposes. The size of universal beam required in each situation can be seen to be markedly different.

As indicated earlier, there are other matters that should be considered when analysing the stability and strength of retaining walls; the size and type of foundation used and the soil bearing pressure quite obviously have major roles to play.

References

British Steel (1996). Structural Sections to BS 4: Part 1 and BS 4848: Part 4. January.

BSI (1993). BS 5502: Part 22. British Standards Institute.

Mason, P A (1992). Farm Waste Storage: guidelines for construction. CIRIA Report 126.

Whitlow, R (1981). Materials and Structures. Longman.

New advances in welding processes - the state of the arc

There have been significant developments in recent years in a wide range of welding and joining processes. New processes like friction stir welding have been invented and they are having a dramatic effect on manufacturing productivity, reliability and profitability. Traditional processes are also continuously being refined and improved.

Organised by The Welding Institute (TWI) on behalf of the Welding & Joining Society (WJS), an event will take place on 16-17 May 2001 at TWI, Cambridge. This event will enable delegates to:

- learn from the experts about all aspects of welding/joining process developments, optimisation and exploitation;
- benefit from expert guidance on the action necessary to increase productivity and reliability in welding/joining manufacture;
- participate in panel discussions where problems and solutions will be aired and gain a better understanding of arc welding developments; friction, electron beam and laser welding developments; new joining processes; and automation;
- have opportunities for networking — creating/renewing business and technical contacts in an informal atmosphere;
- see demonstrations of key process developments.

There will be an opportunity for companies providing goods and services which are relevant to the theme of the event to participate in a parallel exhibition. Welding & Joining Society members will also have the opportunity to attend the WJS Annual General Meeting on Wednesday 16 May.

Further information and enrolment forms are available.

Contact: **The Meetings Section, TWI, Cambridge, UK. Tel: +44 (0)1223 891162. Fax: +44 (0)1223 894363. e-mail: meetings@twi.co.uk**

How easy is it for customers to find your web site?

Many web site owners regard their position in search engines as crucial to their internet marketing. They tend not to favour mass registration with numerous engines because it is not an effective technique, whereas a single high ranking position can bring traffic flooding to the site. It is therefore the selection of appropriate words and word combinations, and the way they are used to give a good ranking in the major search engines, that will reap the greatest rewards.

Choosing the right keywords

Choosing the right keywords is absolutely crucial to success with the search engines. There is the recently heard story of someone who obtained a top 10 position in a major search engine but they became rapidly disappointed when just a few people visited the site - they had chosen unpopular words and phrases. But it's not just a question of selecting words or phrases that many people are searching on - more importantly are they words likely to be used to find your products or services. What are the key words that your potential customers are using? You might need to consider various types of customers. For example, the words used in the UK are frequently quite different to those used by customers in the United States, when searching for the same product or service.

Stop guessing

Resist the temptation to guess. Spend your resources on systematic research. Find out how frequently people actually search for the particular words you have in mind. Of equal importance, determine how many sites are competing for those keywords. Applying effort in this regard is seldom wasted.

Avoid single words

Ranking well on the single word is usually not a good tactic. For example, a high ranking on the word 'motor' is likely to be much more difficult than ranking in the top ten for 'reconditioned electric motor'. For those of you who have a mathematical bent you may realise that single keywords usually return the least targeted leads. If someone is looking for just 'motor' are they:

a) students getting to grips with some aspect of mechanics;
b) looking for someone to refit a new motor to a golf buggy;
c) seeking a replacement motor for their swimming pool;
d) searching for a motor vehicle.

If you sell used cars and optimise your web site for the single word 'motor', only those in category 'd' would qualify as sales prospects. You would get many referrals from search engines if you achieved a good ranking on the keyword, but many of them would leave very quickly. It's the difference between attracting tyre kickers and actual buyers. More importantly, the shear volume of sites usually competing on a single word make it very difficult to achieve a top ten ranking.

The best thing to do is to target multi word phrases that give you the highest quality leads. For example, if you sell software you don't want to waste your efforts trying to rank number one on the word 'software'. It is just too general - not to mention too competitive. The easiest road to success is to target popular keywords that your competitors have overlooked. You should identify those phrases you know from your research are being regularly queried - and where you have identified there is a minimal degree of competition from other web sites. In other words look for the soft spots.

Most get it wrong

It is thought that the majority of web site owners are targeting the wrong keywords. Why do we suspect this? Easy - we look at their computer code and compare it with the words we know are being searched within the search engines. If you put in the resources to target the right keywords in areas where there is minimal competition, you will probably be ahead of 99% of the world and you will be generating more traffic (and better targeted) with less effort.

Once you have the right words and phrases you then have to make them visible (and attractive) to search engines - but that's another story.

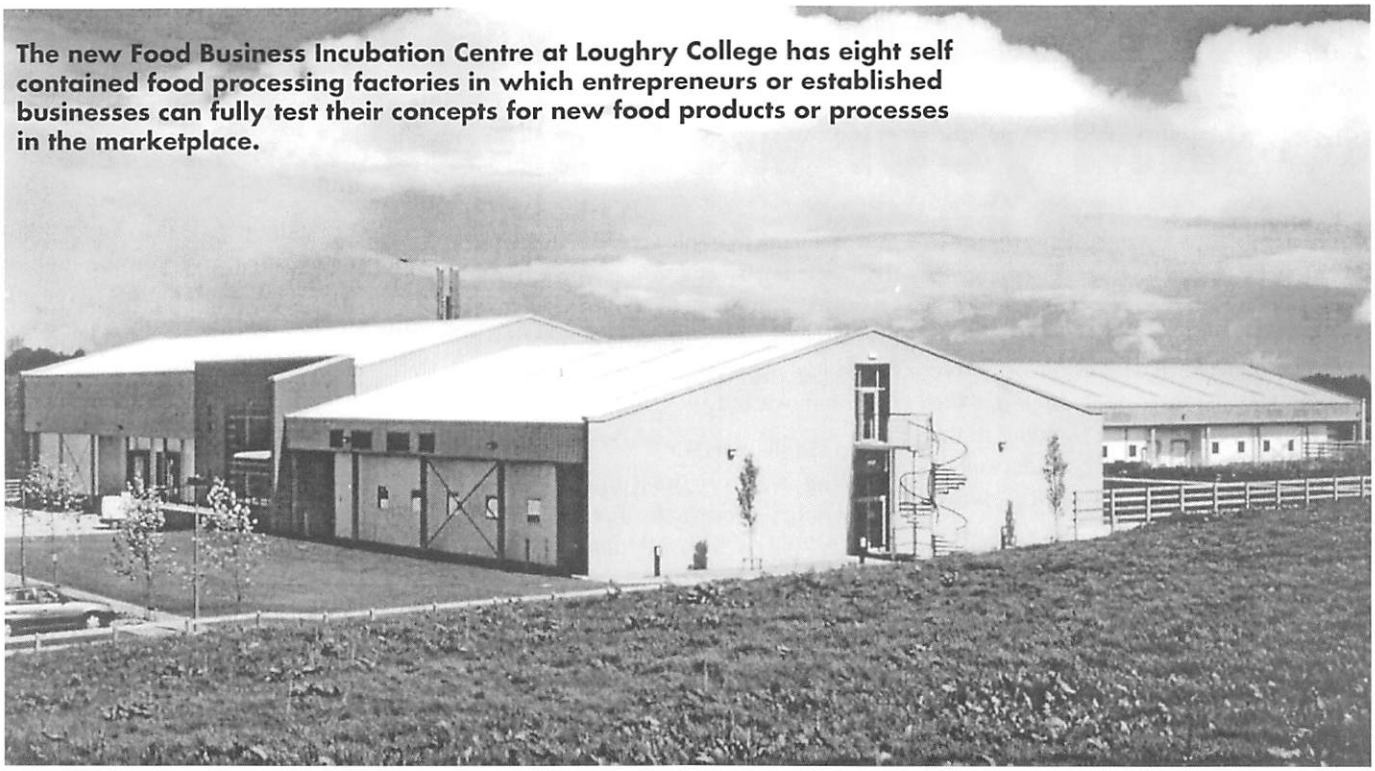
Contact: **Mike Wetton, Allery Scotts Ltd. Tel: 01454 329713 E-mail: mike@alleryscotts.com Website: www.alleryscotts.com**

New HSE Chief Inspector of Agriculture

The Health and Safety Executive (HSE) has today appointed Linda Williams as HM Chief Inspector of Agriculture. Mrs Williams is already the HSE Director for the Midlands Division and takes on responsibility for agriculture following the retirement of David Mattey. In addition, the Health and Safety Commission (HSC) has appointed Mrs Williams as Chair of its Agriculture Industry Advisory Committee (AIAC).

Linda was appointed as an HSE Inspector in 1976 and since then has dealt with a wide range of businesses in various parts of the country, which included a period working in a Policy Section on the development of the COSHH (Control of Substances Hazardous to Health) Regulations. She was Area Director in South Yorkshire and Humberside and most recently the Field Operations Director in Scotland. Mrs Williams said 'I am looking forward to my new role but I am well aware of the challenge it presents. Over the past few months I have been reading, with some concern, the reports of fatal and major accidents that are occurring in the industry - particularly those involving children, mobile machines and work at heights.'

'Two of my main aims will be to work with the industry to reduce the number of accidents involved in these operations and agree how the Government's Revitalising Health and Safety strategy is to be applied in agriculture, fore



The new Food Business Incubation Centre at Loughry College has eight self contained food processing factories in which entrepreneurs or established businesses can fully test their concepts for new food products or processes in the marketplace.

Engineering change in a dynamic global food market

Dennis Legge

Introduction

Agri-Food has long been the largest industry in Northern Ireland. Over 20,000 people are directly employed, manufacturing a wide range of quality products which in 1999 had a value of £2.5bn, 50% of which was exported to discerning customers across the world. A further 20,000 people are employed in the retail, wholesale and food service sectors while approximately 55,000 people on farms are involved in the production of the quality food raw materials. In regional terms, this is an industry vital to the economy; in global terms however, a very small industry indeed!

The environment in which all businesses have now to operate is rapidly changing and our food industry, like many others, has to face significant challenges. Processors and businesses in the food supply chain have now to accept that they operate in a global workplace — a World Economy — one that is increasingly knowledge based and knowledge driven.

Capital for projects is now more mobile and technology spreads quickly. Goods can be made in low cost countries (*e.g.* in an enlarged

This paper was presented, under the title of 'Developing People', at the Institution of Agricultural Engineers Annual Conference 'Food for Thought', held at Edinburgh in May 2000.

Dennis Legge is Head of Food Technology Division at Loughry College, The Food Centre, Cookstown, Co. Tyrone, Northern Ireland. Loughry College is an integral part of the Agri-Food Development Service of The Department of Agriculture and Rural Development in Northern Ireland. It aims to improve the economic performance of the Agri-Food Sector by developing the competence of people entering or engaged in the Sector.

For over 90 years the College has acted as an agent of change in the industry, encouraging innovation, promoting the adoption of appropriate technology, providing technological advice and delivering a comprehensive range of education and training programmes to meet the needs on individual businesses and the industry as a whole.

Europe, South America or the Far East) and easily transported to more developed markets. Ideas, like capital, can travel the world just as fast as fibre optics and satellites permit. It is now possible for consumers to order food from a retailer using the internet from the comfort of their home or by mobile telephone.

Businesses must therefore be able to learn faster and act smarter if they are going to gain competitive advantage in future. They need to develop the skills and competences to recognise and to fully exploit the many new and exciting opportunities brought about by this rapidly changing environment.

The market for foods produced in Northern Ireland and the United Kingdom is very dynamic. It is influenced by many economic, social and technological factors. However, it is likely that the changing life styles and spending patterns of consumers will have the greatest impact on the future overall market for food. This may also offer producers, processors and retailers the greatest opportunity for sustainable business growth.

A world market

There is now a world market for food raw materials. Some processing and retailing businesses within the UK are already sourcing high quality (but cheap) raw materials from countries such as Argentina, Australia, Botswana, or the Far East.

Reform of the Common Agriculture Policy, Agenda 2000 and World Trade Organisation plans will continue to reduce the levels of support to producers in Europe and force them to compete globally at world prices.

As the farmers of Eastern European countries, in an expanding EU, adopt more technology and modern practices, they will present further competition for UK producers. These new entrants will also benefit from a re-allocation and targeting of EU Structural Funds, leaving less available for these islands.

One of the incubation centre businesses completes a production run on a new microwave product for a UK multiple.

Power of retailers

The GB food retailing multiples account for over 50% of all food sold in Northern Ireland. They dominate the retail market in the UK and use their position of power to make demands on producers and processors in terms of price, quality and service. These demands are likely to continue as the multiples compete for market share and respond to mergers and globalisation.

Mergers and acquisitions within the food processing sector in the UK and across Europe are also rife, establishing bigger companies with the increased capacity to service global retailers. These large businesses have the economy of scale to give them competitive advantage and working capital to invest in innovation or new technology to maintain market position.

Consumer attitudes

Consumer attitudes to food are also changing. They want more freshness, more variety, more convenience, different tastes and textures, better quality and value for money. They now expect or demand that the food they buy is safe for their family to eat and, if possible, ethically produced.

Consumers are also much more aware of food related health issues. Over the past five years, there has been considerable growth in the demand for foods that are 'reduced' or 'low in' certain ingredients — taking what were perceived to be the 'bad things', such as fat, salt, sugar out of food. More recently, the trend is to have ingredients, such as vitamins, minerals and probiotics, 'added' to foods; putting 'good things' in — to promote better health in a proactive or positive way or indeed to target specific health problems.

Demographics

We have a different population age and household mix in Northern Ireland compared to that of the rest of the UK. A younger population (22% people under 15 years) that often eats different foods, at different times (if not grazing constantly!) and in different places from the rest of the family!

We also have fewer older people (19% of the population or 220,000 people over 65 years) than the UK. However, this consumer group has different needs and expectations for food. They would like traditional foods with quality, convenience portion size and value-for-money benefits, in packaging that can easily be opened and re-closed.

Of the 540,000 homes in Northern Ireland, over 25% have single occupants, over 50% have one or two occupants and 24% have retired occupants. Over 70% of all homes now have microwaves and 90% have freezers. This improvement in

kitchen technology (and also in the living room — with digital TV, videos, computers) has resulted in meal preparation times being reduced. Meals that took over 2 hours to prepare in the 1960s now take less than 30 minutes.

The demand to free up time has continued to increase as people find other more important things to do with their available time. There are less formal meal times for the family and people want access to food quickly and if possible, all day. This demand and the apparent loss in traditional kitchen skills, have a significant effect on consumers, purchasing and eating habits.

Eating out

People are in general eating out more and, because of changing age profiles and lifestyles, many food choices are being made closer to the time of consumption. Restaurants, pubs and the in-store diners of retail multiples are all enjoying growth. An extensive range of convenience 'carry-out' type food is readily available through global companies, such as McDonalds', KFC and Pizza Hut, over the hot or cold delicatessen counters in the supermarket or through individual High Street outlets.

Approximately 30 pence in every pound spent on food is now spent on food consumed out of the home (in the USA this is currently 60 cents in every food dollar!). We are fast evolving into a '24 hour society' where we will expect food to be available on demand wherever, whenever and in whatever form consumers wish — at no extra cost! A market for food in which convenience and taste are the key factors. The Food Service sector, which currently provides only some of the existing venues and meal options for consumers, predicts that this market will grow to at least 50% of total spending on food by 2010.

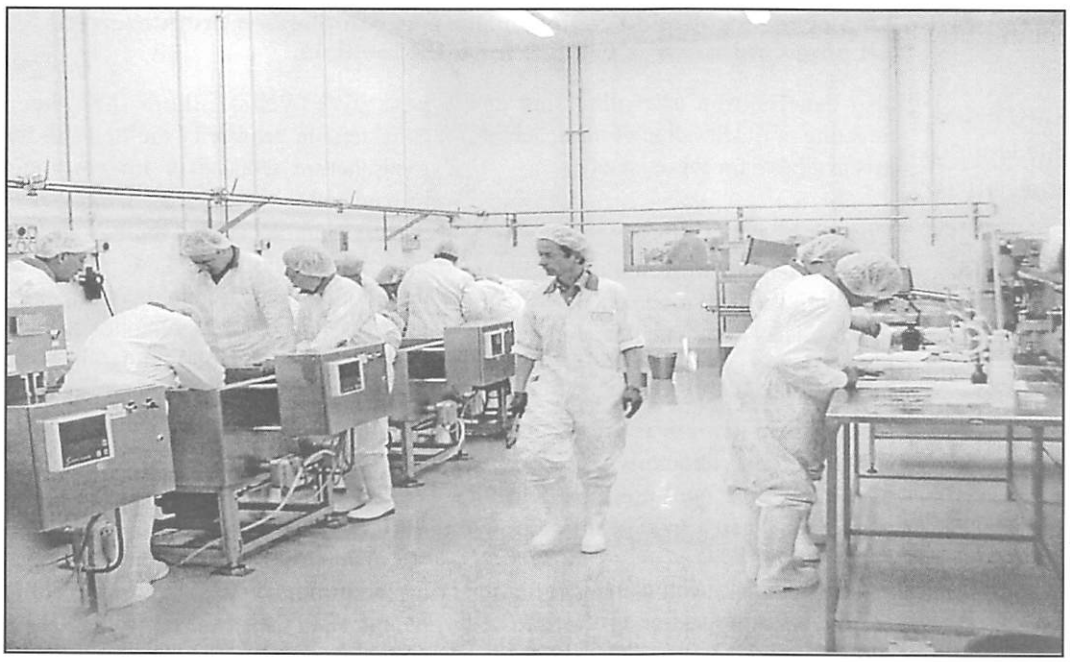
These societal and lifestyle changes are going to blur the boundaries of a traditional food supply chain — in terms of where food is prepared and where and when it is eaten. They will therefore have a significant impact on the food retail sector —requiring, if market share is to be maintained, a change in attitudes and policies as to how food is presented to the consumer. They will affect the types of food manufactured in future and, in turn, require a greater flexibility and agility by food processors and in on-farm production. Such changes will therefore provide real opportunities for existing and new entrepreneurial businesses — in production agriculture, in food processing, or indeed, in retailing — to tackle this rapidly growing food service market.

Future challenges

The revolution in information and communication technology, a global workplace and changes in consumer demand will alter how all businesses operate in future. There will be more competition at home and abroad. And whilst keeping costs under control will continue to be important, businesses also need new products, improved processes, and better organisational and management systems to help them differentiate themselves in a competitive fast moving market.

To be successful, they will need knowledge and skills, not just at operative levels but throughout the business. Owners and managers need knowledge about their customers, their markets, the latest technology and to benchmark their own performance against best practice elsewhere. The Industry must encourage a culture of enterprise and people with self-reliance and the innovative skills that can turn good ideas into reality.

In respect of agricultural engineering, we need people who can look along the complete supply chain from consumer to farm and who can 'interact' between processing and production. They need, for example, to improve cultivation systems, automate harvesting equipment, reduce harvesting waste, take field heat out of the product and control the transportation and storage environment or design pack houses to meet world class standards. They need to ensure that the design of our livestock handling systems actually contributes to quality and improves welfare.



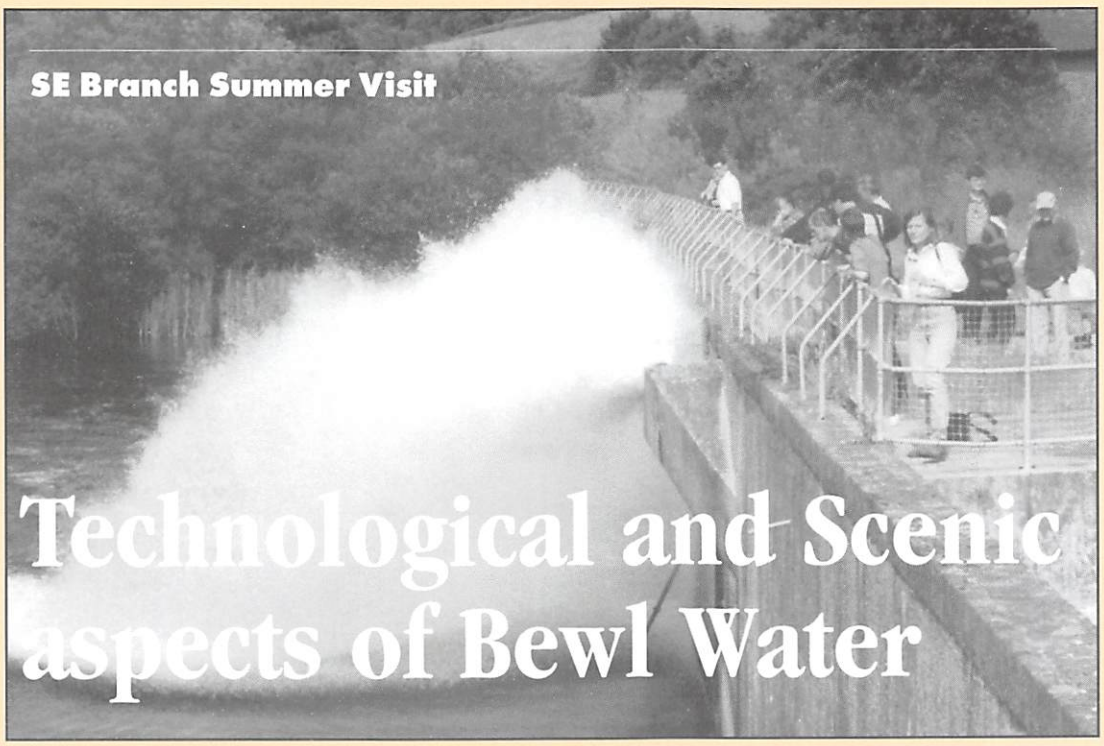
A farmhouse cheese manufacture training programme underway in the milk processing area of the Food Technology Building.

Conclusion

Change is now a way of life! Agri-food businesses will be successful if they can anticipate the future, grasp the opportunities that it creates and 'engineer' or at least manage change effectively.

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Winter 2000



SE Branch Summer Visit

Technological and Scenic aspects of Bewl Water

Water being released from the reservoir into the River Bewl: maximising essential aeration for river conditions

It came as a very pleasant surprise, for those attending the SE Branch Summer Visit on 1 June 2000, to discover the scenic expanse of Bewl Water tucked away in the rolling landscape of the Eastern Weald - something not generally regarded as typical Kentish countryside. Bewl Water, a reservoir covering approximately 320 ha and completed in 1975, is one of the principal components of Southern Water's Medway Catchment Scheme supplying water for the domestic, commercial and industrial requirement of nearly 0.5 million people in NW Kent. Apart from its outstanding scenic value Bewl comprises a centre for a wide range of leisure and conservation activities - although these aspects were subsidiary to the main purpose of the SE Branch's visit they were very much enjoyed by all and, particularly, our accompanying families.

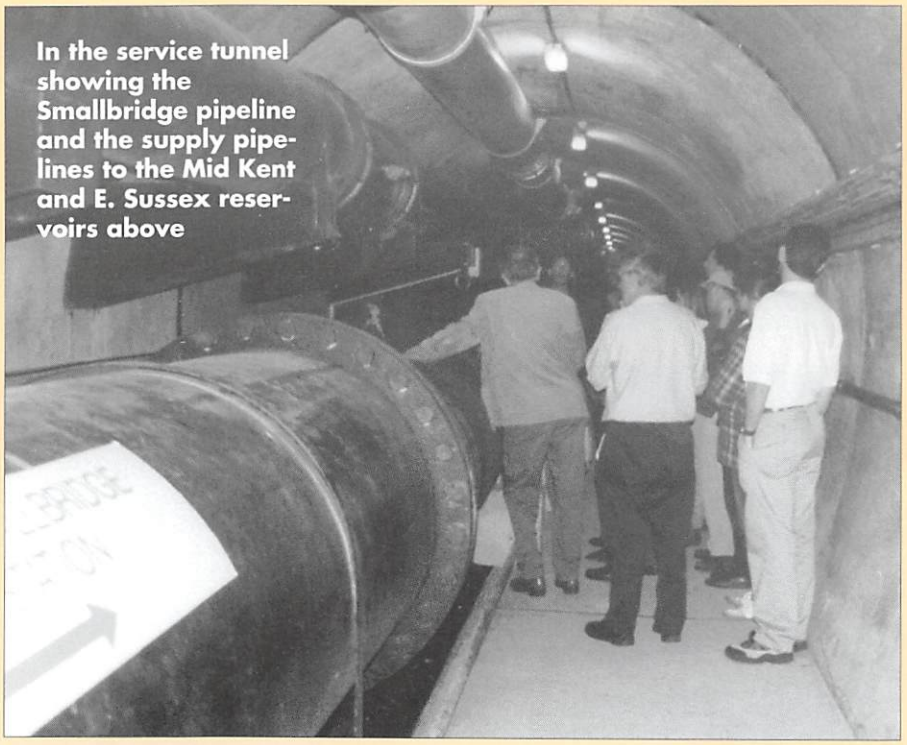
An immediately striking feature on approaching Bewl Water is the way in which the 900 m long, rolled clay and sandstone retaining dam, located at the outfall of three converging valleys centred on the River Bewl, blends so completely with the surrounding landscape. At first sight, the reservoir could quite easily be taken as a naturally formed lake and its twin draw-off and overflow towers were the only obvious indication that this is not the case. Bewl Water has a maximum capacity of approximately 31367 M*l* and its principal function is to act as a 'buffer' reservoir supplying water to the River Teise (a tributary of the Medway), maintaining water flow year-round, essential for abstraction at downstream pumping stations which supply the North Kent water-treatment works. A second task is that of providing a top-up facility via separate pipelines to storage reservoirs in E. Sussex and Mid Kent - all part of the Southern Water Services infrastructure.

Our tour of the dam installation started at the overflow outlet downstream from the dam itself, located more than 30 m below the reservoir's maximum water level, where we were greeted by a spectacular jet of water discharged into the River Bewl (a tributary of the Teise). Thence through a 230 m long, service tunnel taking us under the dam to a point, below the reservoir bed, at the base of the 40 m lift shaft running up the centre of the take-off tower. We finally emerged via the lift into daylight on the platform at the top of the tower, from which vantage point we had an impressive 360 degree view across the water.

A feature of the scheme of particular interest to us was the topping-up system employed. Largely because of the local topography combined with a relatively low annual rainfall, water yield from the natural Bewl catchment area is insufficient to maintain a full reservoir. This factor was taken into account at the outset with the Smallbridge pumping station located on the river Teise, capable of abstracting and returning 136 M*l*, daily, via a 6.5 km, 1 m diameter pipeline to the reservoir. This return pumping normally takes place through the winter months when flow rates in the river Teise are high. But it can be used at any time of the year whenever the river happens to be in spate. Increasing water demand and a generally lower summer rainfall pattern in recent years have necessitated the building of a second pipeline to ensure an adequate top-up facility. Completed in 1994, this second 20 km pipeline takes water from

the Yalding pumping station on the Medway. At 1.5 m in diameter, it has a maximum abstraction/delivery capability of 250 M*l* in 24 h - not far short of 1 per cent of the reservoir's maximum capacity! Both pumping stations are unmanned, each being equipped with a battery of variable-speed pumps controlled automatically to modulate the water pumping volume according to river flow rates.

Our visit to Bewl gave us a unique insight to the technicalities of a major water-supply scheme. It also illustrated how a water-supply utility had successfully capitalised on the opportunity of creating a major amenity and conservation facility. There was something for everyone in our mixed group - for this we are indebted to our guide James Garratt of Southern Water Services and to Vaughan Redfern of the SE Branch for organising this interesting event.



In the service tunnel showing the Smallbridge pipeline and the supply pipelines to the Mid Kent and E. Sussex reservoirs above

obituaries

Charles Lewis Fox

Mr Charles Lewis Fox, for many years Head of the Mechanisation Department at the Lindsey College of Agriculture at Riseholme, has died after a short illness.

He came of a farming family but as he himself put it: "Once I had seen the public display by the Royal Corps of Signals, that was the place for me". So after the outbreak of hostilities in 1939, he joined the regiment and saw much hard service with them mainly in the Mediterranean sphere.

After demobilisation, he became aware of the great changes that were taking place in British Agriculture and was convinced that the future lay in the further development of mechanisation. To gain further practical experience in this field he obtained a secondment to the well known firm of A. Goodall and Sons who were large farm contractors and traditional rural engineers based at Welton near Lincoln.

When the Riseholme Hall complex was developed as part of the resettlement of ex-service men, he joined the staff there in charge of farm mechanisation and later, when Riseholme became the Lindsey Farm Institute, he was appointed Lecturer in Farm Mechanisation.

Over the years and through the conversion of Riseholme Farm Institute to a College of Agriculture, he continued in charge of the Mechanisation Department, developing the workshop and promoting good practice in mechanisation both amongst the resident students and increasingly by extra mural work in the wide farming area of North Lincolnshire. Here, he was responsible for setting up a number of Farm Machinery Clubs and was an external examiner for the City and Guilds of London Institute in Agricultural Mechanics work.

A keen amateur photographer, he developed a substantial library of visual aids to assist in his work. This skill was put to good use when an excavation programme of the Roman remains was undertaken at Riseholme and his pictures of some of the findings appear in Florence Baker's History of Riseholme.

A member of the Institution of Agricultural Engineers for many years he was active in promoting it's interests in the County being a past Chairman and long serving Committee Member of the East Midlands Branch for many years.

But perhaps the most outstanding feature of Lewis Fox's life was his religious convictions. He became an accredited Local Preacher in the Methodist Church in 1935 and continued in this role, albeit with reduced commitment as his health deteriorated, until his death. So his service as a lay preacher covered a span of 65 years, a notable contribution to the work of his church.

He was also treasurer of the Burton Road Methodist Church in Lincoln and when he retired to live at Saxilby, he became a strong supporter of the Methodist Church at Stow, the small village traditionally taken as the centre for the spread of the Christian faith in Lincolnshire.

During his military service as an avowed nonconformist there might be some latitude in regimental discipline in the matter of attendance at the Anglican Church Parades. So whenever opportunity offered he would endeavour to organise Christian worship in accordance with his Methodist traditions.

J. R. Marshall

Ben Burgess 1902 - 2000

It is sad to report the death of Ben Burgess MBE, aged 98. Ben was born on the family farm at Howe, six miles from Norwich, in 1902 and had to take control of the farm at the age of 19 on the death of his father. His interest in matters mechanical lead him to adding contracting and engineering to his farming pursuits.

His ancestors were blacksmiths in 1783 and manufactured a "side delivery reaper" in 1844, which probably accounts for his deep interest in Agricultural Engineering.

Ben's brother Edward had served an apprenticeship with Marshalls of Gainsborough and in the early 1930s introduced their Diesel Tractor. Ben Burgess became the Norfolk dealer using them in the contracting business and starting the machinery dealership which now employs a staff of 120 in three depots in Norfolk and was one of the four original John Deere dealers in the early sixties.

He attended the Paston Grammar School in North Walsham and went on to attend the first agricultural degree course at St Catherine's College, Cambridge.

During the war he served in the Royal Observer Corps and was chairman of a local War Agricultural Committee advising on growing food to further the war effort.

He was a council member of the Royal Norfolk Agricultural Association since 1976 and President of that organisation in 1971. As well as the President of A M & T D A (BAGMA) from 1962-1964, he was a member of their Education & Training Committee for many years. He was a founder member of the local branch of the Institution of Agricultural Engineers.

It was at a school in North Walsham (Admiral Lord Nelson's old school) that he acquired an interest of that period of Naval History, and started collecting items of memorabilia in the country worth an estimated value of £100,000. This collection was recently donated to a charitable trust that is currently setting up The Norfolk Nelson Museum in Great Yarmouth.

Ben died in his sleep on the 4 November 2000 and was buried at the village church at Howe, the family home. A memorial service was held in Norwich Cathedral on Friday, 10 November 2000 where over 800 people attended.

His daughter, Elizabeth and one of his three grandsons run the family farm. The engineering business is run by a board of directors and Ben Turner, the eldest grandson, has recently been appointed Joint Managing Director.

Malcolm H Fuller, CIAgrE

Textbook offer for less developed countries in Agricultural Engineering

As a result of marketing changes, Associate Professor Cliff Studman, the author of the textbook 'Agricultural and Horticultural Engineering', has acquired a number of copies of this textbook which he is prepared to make available free of charge as class text sets to teachers in universities in less developed countries. Sets of books are available in cartons containing 24 copies. University teachers in developing countries who wish to take advantage of this opportunity should contact Cliff, giving details of their university course and the numbers of students involved.

The textbook contains 500 pages of engineering material for first and second year degree students in agricultural and horticultural engineering. Included in the contents are chapters on surveying, the engineering approach, basic physics and modelling systems, workshop methods and welding techniques, hydraulics and farm water supply principles, electricity and electronics, power systems, thermal systems, building structures and design, including soils, foundations, concrete, timber and steel, greenhouses and fruit support structures, stock fencing design, electric fencing, milking machine technology, the design of milking sheds, post-harvest systems, and an introduction to environmental pollution issues.

The coverage is aimed at students who have a limited understanding of engineering, who wish to undertake courses in agriculture or horticultural science. First published in 1990 by Butterworths, it has been adopted in a number of universities as a text for students.

The offer to less developed country universities is made on the understanding that the books will not be offered for resale, and that they would be retained by the university lecturer concerned as a set of text books for student use over a number of years. The receiving university will be required to pay the cost of shipment of the text book sets from New Zealand. The offer is made subject to stocks being available and is on a first come first served basis.

For other universities, copies may be obtained by contacting the author. The cost is $30 US plus the cost of postage from New Zealand (around $16).

[Cliff Studman attended the AgEng 2000 International Conference at Warwick this year where a number of participants obtained copies of the textbook through this generous offer. Editor]

Contact: **Associate Professor Cliff Studman, Director, Centre for Postharvest and Refrigeration Research, Institute of Technology and Engineering, Massey University, Palmerston North, New Zealand; e-mail: C.Studman@massey.ac.nz**

Long service certificates

50 years

Name	*Grade*	*Date of Anniversary*
Kenneth Henry **Lane**	IEng MIAgrE	21 Nov 2000

35 years

Raymond Parr **Wainwright**	IEng MIAgrE	6 Oct 2000
Jonathon **Sarsfield**	IEng MIAgrE	13 Oct 2000
Giles Anthony Nicholas **Harty**	IEng MIAgrE	26 Oct 2000
John Lester **Atkinson**	IEng MIAgrE	26 Oct 2000
William James **Gale**	AIAgrE	26 Oct 2000
Andrew Lewis **Baldwin**	FIAgrE	26 Oct 2000
William Richard **Butterworth**	FIAgrE	26 Oct 2000
Roger John Owen **Thomas**	FIAgrE	26 Oct 2000
Thomas **Waugh**	IEng MIAgrE	26 Oct 2000

25 years

David George **Wilson**	EngTech AMIAgrE	23 Oct 2000
Christopher John Tasker **Lee**	AIAgrE	23 Oct 2000
Peter Christian **Baker**	IEng FIAgrE	8 Nov 2000
Robert Towers **Smith**	IEng MIAgrE	8 Nov 2000
Paul Salomo **Imonigie**	CEng MIAgrE	9 Nov 2000
Richard Trevor Dunkley **Jones**	EngTech AMIAgrE	28 Nov 2000
Ian Drummond **Mitchell**	EngTech AMIAgrE	29 Nov 2000
Prithiviraj **Oogarah**	IEng FIAgrE	1 Dec 2000
Richard James **Cole**	MIAgrE	30 Dec 2000

Diary date:
15 May 2001

"Information Engineering"

With electronic control systems fast becoming the norm for new equipment, agriculture and horticulture are becoming increasingly reliant upon data handling systems for the control of machines, equipment and environment. The conference will examine the development of advanced control and instrumentation systems on areas that will impact on the way farmers and growers produce food for increasingly competitive markets

See announcement on inside front cover

SCOTTISH BRANCH SUMMER OUTING

Forth Bridges cruise

An evening cruise on the 'Maid of the Forth' was greatly enjoyed by members and wives in August. Although the sunset over the famous 'Forth Bridge' was marred by cloud, the trip was smooth and pleasant. Seals were seen off Inch Colm Island and we marvelled at the size of the oil tankers loading at Hound Point. The illuminated Kincardine Power Station formed an impressive backdrop to the night sky.

Planning for profit

Companies are not paying enough attention to the bottom line. Yet every one of the 439 companies included in the new *How To Plan for Profit: Agri-Machinery Edition* from Plimsoll Publishing, could deliver more profit. This latest publication identifies three business plans predicting what could be achieved and allocates one to 439 companies in the industry.

The three business plans are the:

- Consolidation Plan for the 28% of companies losing money;
- Tweak Plan for the 53% of companies to maximise current performance;
- Expansion Plan for the 19% of companies in a strong position.

The Consolidation Plan

125 companies are currently loss making and costs are too high for sales. These companies need to lower costs immediately in order to downsize in the short term to build for a future. The Consolidation Plan suggests losing 10% of their market for one year and opts to reduce costs and overheads to give a return to profitability.

The Tweak Plan

231 companies need to maximise their current performance. These companies need to refine before moving on to give a better return on capital and a leaner looking balance sheet. The Tweak Plan takes a zero growth approach in order to maximise profits.

The Expansion Plan

83 companies need to expand on their winning formula. These companies are winning at the moment, yet they need to exploit this winning position. An Expansion Plan was produced to explore how these companies might keep this winning formula and grow. Plimsoll suggests the plan begins with a 10% growth in sales.

Predicted achievements of these plans

The Consolidation Plan

Putting this theory to the test, Plimsoll brought every one of the 125 loss-making companies with this plan into profit from a pre-tax loss of 3.5% to a pre-tax profit of 4.6% on average. This was not without casualties as jobs and overheads were trimmed significantly. Vital to such companies' survival is an achievement of more profit from the same assets. Sales per employee figures crucially increased from 118,000 to 130,000 per employee on average with this plan.

The Tweak Plan

The implications for many are slight, yet significant if these 231 companies are to build a solid foundation from which to expand. For some, this requires reducing loans and interest payments, thereby retaining more profit in the company for future investment. On average, this tweak lifted pre-tax margins from a reasonable 1.9% to a much healthier 4.7%. Sales per employee also increased from 133,000 to 146,000 per employee on average with this plan.

The Expansion Plan

The potential for extra profit on the 83 companies is massive in this plan even allowing for rising assets and reductions in cash. Arguably many of these companies' sales are capable of growing at a faster rate than 10% suggested. Many must consider acquisition if they are to move quickly and not lose out.

Your challenge

Take a look at how your competition might behave in the future and what options they may have. Can you or they share in the additional 1.4 billion profit created in this future Agri-Machinery industry? Remember each individual company is capable of delivering more profit. Achieving these plans is the challenge!

What's in the pack?

An individual analysis of 774 UK Agri-Machinery companies including the 439 with a 'plan for profit year' added based on one of the three possible business plans. *How to Plan for Profit: Agri-Machinery Edition* plus a complimentary electronic version is available for £305. *Readers can obtain a 5% discount when mentioning this article upon ordering.* Or for a full list of the companies included visit our website at www.plimsoll.co.uk.

Contact: **Jennifer Ovington, Plimsoll Publishing Ltd, The Vangard Suite, Broadcasting House, Middlesborough TS1 5JA. Tel: 01642 257800**

Membership movements

Mem No	*Name*	*From*	*To*
6777	E S A Ajisegiri	Germany	Nigeria
6524	P W Amos	Penrith	Edinburgh
6662	J K Bailey	Bedfordshire	Derbyshire
6620	S J Brown	Leicestershire	Germany
3527	D N H Dagg	Ghana	Eritrea
6668	G M Gillespie	Ireland	Canada
6042	G P Higginson	Essex	Shropshire
6558	A M Lawson	Stafford	Cheshire
6772	M Mutema	Gloucestershire	Berkshire
6518	M W Peters	South Devon	Australia
6754	T L Pomeroy	Worcestershire	Gloucestershire
3879	M G H Reid	Cornwall	West Midlands
5742	N S Taylor	Berkshire	Cornwall
5969	S J Twomlow	Bedfordshire	Zimbabwe

Gone Away

Name	*Last known address*
Johara Bellali	Cranfield University, Silsoe, Bedford MK45 4DT

Institution Membership changes

Admissions - a warm welcome to the following new members

Associate Member
A Hudson (Northern Ireland)
K S Sebolao (Botswana)
A G Smith (Warwickshire)

Associate
P E Pettifer (Bedfordshire)

Student
L P Caussiol (Bedfordshire)
J E G Cook (York)
A P Curry (East Yorkshire)
T D Jewers (Shropshire)
C E Owston (Durham)

Transfers - congratulations on achieving a further phase of your professional development

Member
A D Gregory (Hertfordshire)
T J Wright (Nottinghamshire)

Associate Member
J K Bailey (Derbyshire)
A M Buchanan (Buckinghamshire)
D Bunting (Cumbria)
M A Conroy (Ireland)
J Cowie (Fife)
M E Hinton (Suffolk)
I S J Jensen (Wiltshire)
A M Lawson (Cheshire)
W G Mulholland (Co Armagh)
T P Roddy (Essex)

Associate
S H M Aikins (Bedfordshire)
J Bellali (Bedfordshire)
S A Bentley (West Sussex)
A N M Bolton (Co Antrim)
D Chan (Lancashire)
R J Craven (Essex)
I H J Cromie (Co Down)
C G Cuinnea (Ireland)
J R Evans (Northamptonshire)
B J Jackson (Ireland)
P J E Jones (Wrexham)
L K Jordan (Essex)
K A Naylor (Lincolnshire)
R Paterson (Lanarkshire)
D L Pendergrast (Bedfordshire)
T L Pomeroy (Worcestershire)
M J Powell (Staffordshire)
R C Richardson (Bedfordshire)
J E Rigby (Lancashire)
G A Ross (Aberdeenshire)
D Sayer (North Yorkshire)
T I Stacey (Shropshire)
A J Watts (Bedfordshire)

Reinstatement

J A I Jayasinghe (Sri Lanka)

Deaths -with great sadness, we record the deaths of:
B Burgess (Norfolk)
F Coleman (Wiltshire)

Engineering Council Registrations

IEng
T J Wright (Nottinghamshire)

Commercial Members

Bomford Turner Ltd
Salford Priors, Evesham
Worcestershire WR11 5SW

BSW Harvesting Ltd
Robertson House, Perth Business Park
Whitefriars Crescent,
Perth PH2 0NX

Douglas Bomford Trust
16 The Oaks, Silsoe
Bedford MK45 4EL

Farm Energy Centre
NAC, Stoneleigh, Kenilworth
Warwickshire CV8 2LS

G C Professional Services
Highdown Cottage
Compton Down
Hampshire SO21 2AP

Law-Denis Engineering Ltd
Millstream Works, Station Road
Wickwar, Wotton-under-Edge
Gloucestershire GL12 8NB

Spencer Environmental Care and Construction Ltd
Llwyn-yr-ynn, Llandeilo Road
Gorslas, Llanelli
Dyfed SA14 7LU

White Horse Contractors Ltd
Lodge Hill, Abingdon
Oxon OX14 2JD

Academic Members

Cranfield University
Silsoe
Bedford MK45 4DT

Harper Adams University College
Newport
Shropshire, TF10 8NB

Lackham College
Lacock, Chippenham
Wiltshire SN15 2NY

Pencoed College
Pencoed
Bridgend CF35 5LG

Sparsholt College
Sparsholt
Winchester
Hampshire SO21 2NF

Writtle College
Chelmsford,
Essex CM1 3RR

Sustainable development and poverty relief

Organised by the Commonwealth Engineers' Council, the aim of the Commonwealth Young Professional's Millennium Conference on 14 March 2000 was to mark the Millennium and advance the debate on sustainable development and the relief of poverty. The conference was attended by over 160 young professionals from the Commonwealth with representatives from all engineering disciplines.

The event centred on the relief of poverty and how engineers could contribute to the international development target to halve poverty by the year 2015. The conference commenced with an address by Her Royal Highness the Princess Royal followed by workshops on Food and Agriculture facilitated by Professor Mike Carr (Tropical Agriculture Commission), Appropriate Technology by Peter Guthrie (Institution of Civil Engineers), and Water Issues by Ray Heslop (Water Aid). There were also workshops on housing, infrastructure, population and health, communication and IT, education and aid. It was evident throughout the conference that Agriculturalists, and in particular Agricultural Engineers, will provide an important role improving basic living standards for the 1.3 billion people who live in absolute poverty, (the majority of which live in rural areas and whose livelihoods are related or dependent on agriculture).

The workshops demonstrated the strengths and importance of the agricultural engineering discipline in helping to assess the needs of rural communities, overcoming barriers to technology adoption, developing appropriate technologies and offering management solutions to ensure technologies will be sustainable and flexible.

Engineers were asked how sustainability could be achieved. A consensus emerged that human capital development, mainly through improved operator training, maintenance supervision and managerial assistance is required to enable rural people to achieve value for money and maximise returns from technology investments. Many participants reported that absence of operating cost information in many developing countries hinders appropriate technology choices. Service support was also considered essential to ensure longevity of technology in the field.

There was concern that elegant and sustainable solutions generated by engineers were continually compromised by current economic, infrastructural and institutional conditions in developing countries. Frequent policy changes, or even lack of policy, shortens managers planning horizons, compromising financial planning for technology investments. Whilst engineers could design appropriate technologies, it is necessary for governments to foster the optimal economic and infrastructural conditions to enable engineering solutions to operate. Discussions centred on building the appropriate supporting infrastructure for technologies. To achieve this, engineers should forge partnerships with disciplines such as economists, environmentalists, sociologists, anthropologists and project co-ordinators so that these latter disciplines have empathy with the needs and benefits of appropriate well managed technology.

Industrial placements, interpersonal skills development and management training are elements engineers want incorporated into their training. I was able to report that Cranfield University and Harper Adams have pre-empted this market demand with provision of management, economics and business modules in their courses, combined with supervised industrial placements.

The workshops concluded that the poor are heterogeneous, seeking livelihoods from a number of sources, and whilst each individual is not a budding entrepreneur waiting to be empowered with foreign assistance, it was acknowledged that the poor are very responsive to new opportunities offered by technology.

The challenge is set for engineers to deliver technological solutions that increase agricultural productivity, do not displace rural labour, do not have an adverse impact on the environment and which offer durability, ease of maintenance and most importantly sustainability in the adverse conditions prevalent in economically developing countries. The need for a revival of life cycle costing, an increased consideration of service backup, machine standardisation, improved training and enhanced employee motivation were cited as necessary to ensure the transfer and successful operation of the most appropriate technologies.

Websites for further information:

Sustainable Development and Poverty Relief:
http://www.dfid.gov.uk/
http://www.worldbank.org
http://www.fao.org

Agricultural Engineering for Development:
http://www.fao.org/waicent/faoinfo/agricult/ags/AGSE/Agse.htm

Commonwealth Engineers Council:
http://www.tcol.co.uk/comorg/cec.htm

Institutions:
http://www.iagre.demon.co.uk/ (see page on courses).
http://www.cranfield.ac.uk/
http://www.harper-adams.ac.uk/

Contributed by Ian Petts who is a graduate from Cranfield University, is currently studying for an MSc in Economics at Reading University, and is sponsored by the Department for International Development. E-mail: ipetts@farmersweekly.net

News of Members

Congratulations to **Christine Clark** for being the first female member of the Institution of Agricultural Engineers, who in April 2000 became a 'Fellow'. This is just one of many achievements for Christine who is also one of only two female Chartered Engineers in the Institution, although she originally obtained her CEng through the IMechE. Christine has been a member of the Institution since 1980 and has held many appointments on National and local committees. With so few female members in the Institution (currently just over 1% of membership) it is good to see Christine playing such an active role within the Institution.

Congratulations are also due to **Stephen Temple** who has been awarded a PhD from the University of Wageningen following his thesis on the 'Control of Fluidized Bed Tea Drying'. The research work was carried out during his time as Research Engineer at the Tea Research Foundation (Central Africa). Stephen is now based in Norfolk and amongst other things he has developed an instrumentation package for monitoring temperature and humidity in grain stores and other agricultural applications. Sensors are linked to either a PC or a hand-held Psion. The system is being marketed by Martin Lishman Ltd, Unit 2B, Roman Bank, Bourne, Lincolnshire.

Jim Brook is now working as a Product Manager for service development and training for DeLaval in Sweden (formerly Alfa Laval Agri). He is responsible for training their worldwide market companies in the servicing and testing of milking equipment.

Heuston Dagg has left Ghana to take up a new position as the FAO Representative in Eritrea.

After spending 11 years at Silsoe Research Institute, **Steve Twomlow** has taken up an appointment with the ICRISAT team in Bulawayo. Steve will be based at the Matopos Research Station as the Soil Fertility Management Specialist. His brief is to build on the work that he has been doing with ICRISAT and CIMMYT on participatory methodologies and integrate the experiences in tillage and soil water management with soil fertility management.

Congratulations to **Sandy Donald** for winning the Tractor Driver of the Year 2000 competition. Sandy was one of the five finalists whittled down from an original 1000 entries who took part in the nationwide competition organised jointly by The Royal Agricultural Society of England, Farmers Weekly and the Silsoe Research Institute. Each finalist had to perform five tasks: ploughing, fertiliser spreading, materials handling, combine harvesting and road work with a trailer. Graham Wells, Chairman of the judging committee, said that he was very impressed with Sandy. "We could not spot any weaknesses in Sandy's all-round driving skills and his thorough knowledge of each machine".

Originally from Kelso in the Scottish Borders, Sandy served his apprenticeship with George Hendersons, Kelso, before moving to Borders Regional Council then George Marshall Tractors. In 1984 he moved to Nocton Farms in Lincolnshire and in 1988 he moved to his present job as Farm Workshop Manager with British Crop Driers, now Blankney Estates Limited based at Grange Farm, Navenby, Lincoln. Sandy is responsible for overseeing all repairs of the farm machinery and fixed plant. The fleet consists of over 30 tractors, 2 Challengers, 12 forklifts/loaders, plus combines, beet harvester, cars, vans and lorries. The fixed plant consists of a 20,000 litres evaporation capacity grass drier, 2 mixed flow corn driers and British Chlorophyll Limited machinery which is used to extract the green colouring from the dried grass. Most of Sandy's driving experience has come from testing machinery after being repaired, and in his younger days, by working on a farm after school, weekends and during the holidays. Sandy is married and has three children.

Write to Tony with your news! His address is: 32 Beverley Crescent, Bedford MK40 4BY

Tony Chestney

UK agricultural tractor registrations

Total registrations of agricultural tractors in the UK fell 5.4% to 8,772 in the first 9 months of the year. Registrations in the single month of September fell 20% to 1,187 units.

The decline in the market in September follows a fall of over 18% in August and reflects the difficult position of British farming. In many areas adverse weather has caused problems with the harvest and cultivations have been delayed. To this can be added low commodity prices and escalating input costs so that farmers have had little incentive to consider their investment needs.

The short term situation looks difficult but the trade expects some relative improvement in demand once these conditions abate but it now appears likely that the 2000 market will fall somewhat below the 10,969 units recorded last year.

Produced by: Land Technology Ltd, Edinburgh

Printed by: Barr Printers, Glenrothes

INSTITUTION of AGRICULTURAL ENGINEERS, WEST END ROAD, SILSOE, BEDFORD, MK45 4DU, UNITED KINGDOM. Tel: 01525 861096 Fax: 01525 861660

PA WeatherCentre launches new weather forecasting service for farmers

PA WeatherCentre has launched WeatherCast, a new weather forecasting service, designed to keep farmers up-to-date with the latest meteorological data and accurate weather forecasts, for use in weather-sensitive decision making.

The WeatherCast software, available on a *free* CD-ROM for PCs, uses a modem connection to provide graphically displayed data, as well as UK radar and satellite images, allowing users to view weather conditions at any chosen point on the map. It offers up-to-the-minute weather information including rainfall, wind-speed and direction, temperature and cloud cover statistics, for any location in the UK over a 5-day period. This is the first time in the UK that current actual rainfall radar images have been made available to consumers.

With all the information displayed in a familiar 'Windows' environment, WeatherCast represents an essential resource for farmers. The service connects to PA WeatherCentre's comprehensive meteorological database to provide a vast range of vital weather information. The CD Roms are free, and the data downloaded via a modem is charged at £1 per minute.

Information includes:

- local UK weather observations;
- actual Rainfall radar images, and forecast rainfall images;
- local UK weather forecasts in text, tabular and graphic formats;
- pressure charts, satellite images and precipitation forecasts for UK and Europe;
- 'clickable' charts to reveal local weather conditions and forecasts.

As Paul Mills, Managing Director of PA WeatherCentre, says: 'The weather seriously affects the farming industry, both in the short and long term, and WeatherCast provides a cost-effective way of keeping up-to-date with the latest weather conditions.

As WeatherCast delivers the latest data and forecasts specific to any given location, there's a range of possible applications - for example, farmers can check expected temperature changes before deciding to seed, or wind speed and direction before crop spraying. With rainfall radar on your desktop, you can plot current rainfall situation, and pinpoint when it is likely to reach your location.'

WeatherCast is available on a PC format CD-ROM, and requires a Pentium processor or similar system and a modem. This is compatible with Microsoft Windows 95 or NT 4.0.

Contact: **Paul Mills, Managing Director, PA WeatherCentre Ltd, PA NewsCentre, 292 Vauxhall Bridge Road, London SW1V 1AE.**
Tel: 020 7963 7542
E-mail:
paul_mills@paweather.press.net

New careers pack promotes careers in land-based industries

A colourful and informative pack promoting careers in land-based industries has been mailed to more than 5,000 careers offices, schools, sixth forms, colleges and universities throughout the UK. The pack, 'Careers in Land-based Industries', is designed to appeal to both young people seeking new careers and others considering a career change.

Produced by Lantra National Training Organisation with funding from the Department for Education and Employment, the pack contains a map that outlines the various work-based and academic qualification routes people can take, whatever their level of experience. There is also a section on National Traineeships and Modern Apprenticeships.

At the back of the pack are 10 fact sheets, each covering an industry or career area. They give detailed information about specific careers in the land-based sector, describing the skills needed, possible entry routes and where to get further information. Case studies from students and people established in their careers provide added insight into the opportunities available.

Lantra's development manager Debra Costley said: 'This pack provides an introduction to the exciting, rewarding and varied career opportunities in the land-based sector. We hope that people of all ages will find the case studies inspiring and the information useful as part of their own career planning.'

The pack has been well received by Lantra's industry groups. Jim Marshall of the National Trust and chairman of the landscaping industry group said: 'This is the first time a single brochure has been available containing information on the full-breadth of land-based careers. Its clear and simple qualifications route map will be helpful to both those seeking a career and employers responsible for staff development.'

Contact: **Jane Lewis, Lantra National Training Organisation, Lantra House, NAC, Kenilworth, Warwickshire CV8 2LG. Tel: 024 7669 6996 E-mail: nto@lantra.co.uk**

Branch Diary

East Anglian Branch

For further details contact the Honorary Secretary.

Monday, 12 March 2000 at 7.00 pm
Annual General Meeting and Technical Meeting

Hon Sec: Brian Bell Tel: 01473 890456

East Midlands Branch

For further details contact the Honorary Secretary.
Meeting details are subject to review. All meetings are at 7.30 pm unless highlighted.

Wednesday, 24 January 2001 at 6.00 pm
Venue: LAMMA Exhibition, Newark Showground
Developing export markets and overseas capability
Speaker: To be announced

Friday, 27 February 2001
Venue: Grimme UK, Sutterton, Boston, Lincolnshire
Visit - Latest developments and the manufacturing of potato harvesting equipment

Friday, 30 March 2001
Venue: To be announced
Dinner and Annual General Meeting

Hon Sec: Steve Watson Tel: 01400 275611

Herts and Essex Branch

For further details contact the Honorary Secretary. All meetings are at 7.00 pm.

Thursday, 18 January 2001
Venue: Writtle College
Web design and e-commerce

Thursday, 15 February 2001
Venue: Writtle College
Annual General Meeting followed by:
From HND to MD - How I developed my turf care business
Speaker: A Jarrett, Turfmech

Thursday, 15 March 2001
Venue: Writtle College
Potatoes - to store or not to store
Speaker: Dr C Bishop, Writtle College

Hon Sec: Graham Higginson Tel: 01376 550246

Northern Ireland

For further details contact the Honorary Secretary.

Wednesday, 17 January at 8.00 pm
Venue: Greenmount
The internet and its potential use by farm machinery users and suppliers
Speaker: John McFerran

February
Developments in diesel engines
(Details to be confirmed)

March
Visit and Annual General Meeting
(Details to be confirmed)

Hon Sec: J P Frost Tel: 028 9268 2484
e-mail: peter.frost@dardni.gov.uk

Scottish Branch

All meetings start at 7.30 pm unless highlighted.
Non-members welcome.
For further details contact the Honorary Secretary.

Wednesday, 31 January 2001
Venue: King Robert Hotel, Bannockburn
Members Night

Wednesday, 21 February 2001 at 5.30 pm
Venue: Moredun Foundation, Bush Estate, Penicuik, Midlothian EH26 0PZ
Branch Annual Conference - The commercial aspects of alternative energy
Includes hot buffet

Hon Sec: G M Owen Tel: 01968 675943

Southern Branch

For further details contact the Honorary Secretary. All meetings are at 7.30 pm unless highlighted.

Tuesday, 6 February 2001 at 7.00 pm
Venue: Exel (Tesco) Distribution Depot, Southmead Industrial Park, Collett Road, Didcot, Oxfordshire
Visit - Food warehousing, transport and distribution
Contact: Secretary - prior notification required

Wednesday, 7 March 2001 at 7.00 pm
Venue: To be advised
Annual General Meeting (7.00 pm)
Dinner followed by *After-dinner Address* (7.30 pm)
(Members, partners and guests are all very welcome.)

Tuesday, 3 April 2001
Venue: Rycotewood College, Thame, Oxon
Motor sport engineering

Speaker: Two speakers anticipated from leading racing engineering companies

Hon Sec: O J H Statham Tel: 01296 623736

South East Midlands Branch

For further details contact the Social/ Visits Secretary. Some events require pre-booking.

Monday, 15 January 2001 at 7.30 pm
Venue: Silsoe Research Institute
Integrated poultry management
Speaker: David Filmer, David Filmer Ltd

Monday, 12 February 2001 at 7.00 pm
Venue: Cranfield University
Five Graduate Research Papers:
Force prediction in mouldboard ploughs
by Chris Saunders
Mechanical cloches
by Kim Blackburn
Inter-row weeding
by Matt Home
Aversion of poultry to ammonia
by Emma Jones
Ammonia emissions from free range sows
by Denise Welch

Monday, 12 March 2001 at 7.00 pm
Venue: Silsoe Research Institute
Annual General Meeting (7.00 pm)
Developments in fuel cells (7.30 pm)
Speaker: Dr David Thomsett, Johnson Mathey Technology Centre

Social/ Events Sec: Chris Saunders Tel: 01525 863000
e-mail: c.saunders@cranfield.ac.uk

West Midlands Branch

All meetings start at 7.30 pm, unless highlighted. Location plans are available on request - please contact the Branch Secretary. You are advised to confirm the details on the day, especially if travelling long distances, by contacting any Committee Member.

Monday, 12 February 2001
Venue: National Grid, Coventry
Solid works by Solid Solutions - demonstration of CAD
Speaker: Simon Turner, Solid Solutions
Contact: Mike Blackbrough, Anthony Johnson

Monday, 12 March 2001 at 7.15 pm
Venue: National Grid, Coventry
Annual General Meeting (7.15 pm - 7.45 pm)
Perkins Engines - modern engine developments (8.00 pm)
(Joint meeting with I Mech E)
Speaker: To be announced

Hon Sec: M C Sheldon Tel: 01926 318333

Western Branch

For further details contact the Secretary.

Wednesday, 21 February 2001 at 2.30 pm
Venue: Ford Transit Factory, Southampton
How they make the Backbone of Britain - guided tour and history

Wednesday, 21 March 2001 at 6.00 pm
Venue: Royal Agricultural College, Cirencester
Annual General Meeting (6.00 pm)
4x4 Off-roading (7.30 pm)
Presentation including display of several customised vehicles.
Speaker: Local 4x4 club

David Mehaffy Tel: 01380 722361

Wrekin Branch

All meetings start at 7.30 pm.
All technical meetings will be held at Harper Adams University College, Edgmond, Newport, Shropshire.
For further details contact the Honorary Secretary.

Monday, 15 January 2001
How much more can the diesel engine give?
Speaker: Perkins Engines Ltd

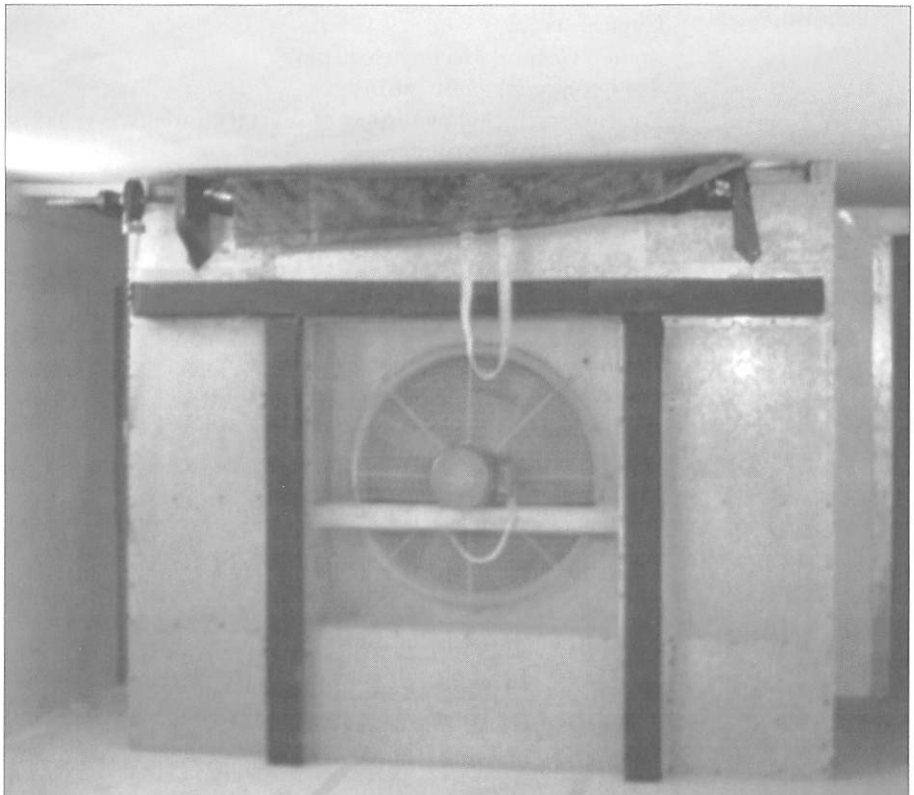
Monday, 12 February 2001
Farm buildings for this millennium
Speaker: Jim Loynes, Harper Adams University College

Monday, 12 March 2001
Annual General Meeting

Monday, 26 March 2001
Plastics v metals - an appraisal of the potential for plastic components in agricultural engineering
Speaker: RAPRA Technology Ltd

Hon Sec: Denis Cartmel Tel: 01785 712690
e-mail: dcartmel@forgecomm.freeserve.co.uk

Performance of wet deck (ice bank) pre-cooling systems with export produce from Egypt



Atef M. Elansari, Anwan M. Hussein and Christopher F. H. Bishop



An evaluation for the wet deck systems installed in Egypt to pre-cool the exported fresh produce is presented. The description of the selected pre-cooling stations is described in detail along with the principle of operation of the cooling process. The mathematical model, which describes the cooling rates and the refrigeration load calculations is included. Three packhouses were selected for that evaluation and table grape was the product which has been chosen to evaluate the performance of the selected pre-cooling systems. The calculated refrigeration load for the four pallets used ranged from 64 to 80 kW. The pre-cooling curves are shown and the calculated seven eighth cooling times ranged from 6 to 8 hours. The performance of each facility was analysed and the advantages and disadvantages of the wet deck systems are presented.

1. Introduction

Pre-cooling refers to the fast removal of the field heat contained in freshly harvested produce before shipment or cold storage of these perishable commodities. Most produce cold storage rooms designed for holding grapes, strawberries or similar produce under refrigeration have neither the refrigerating capacity nor the proper air movement required for rapid cooling. Owing to this situation, pre-cooling is generally a separate process that requires special designed equipment and/or rooms (Thompson *et al.*, 1998)

The rate of pre-cooling of any commodity by forced air-cooling depends essentially on three major factors: (1) the accessibility of the produce to the refrigerating medium (air), requiring adequate ventilation of the container used during the pre-cooling process; (2) the temperature difference between the product and the air temperature of the pre-cooler; and (3) the air velocity through and around the product (Talpot *et al.*, 1992).

One of the main purposes of rapidly cooling the produce is to reduce water

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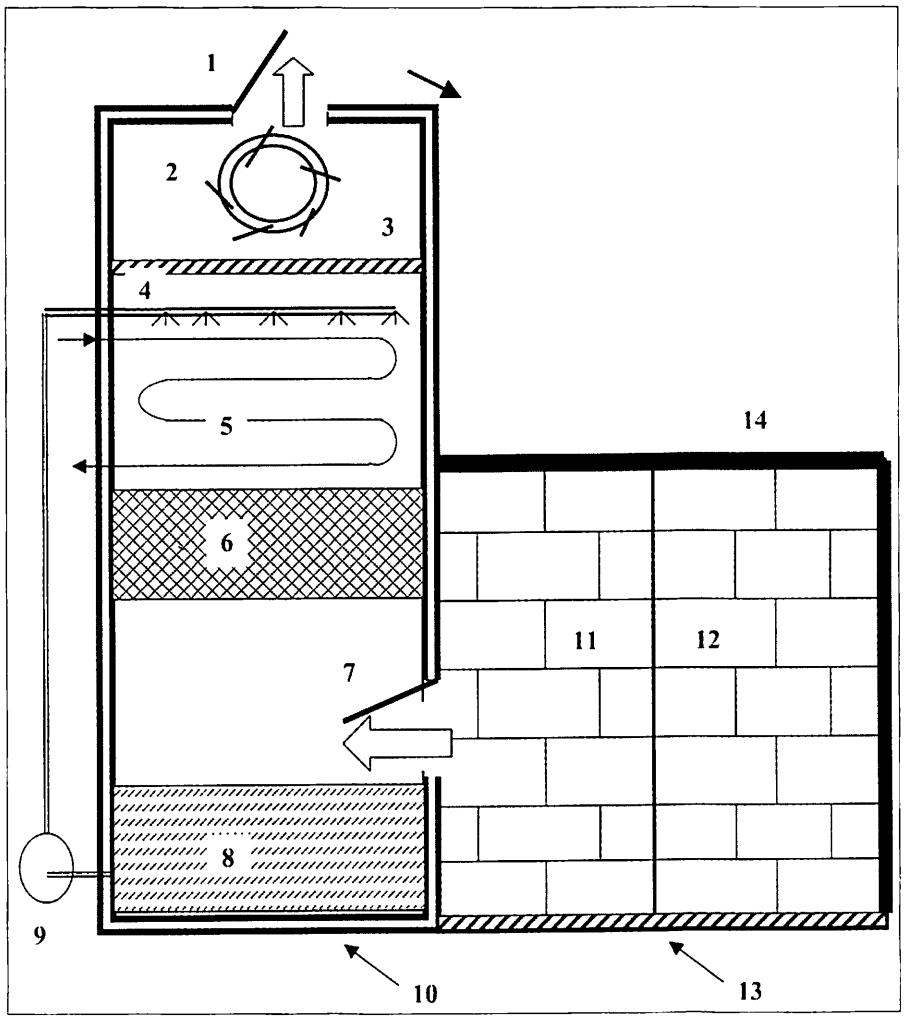


Fig. 1 Illustration of the different components of a typical wet deck cooling system: (1) damper; (2) centrifugal fan; (3) moisture eliminator; (4) water spray; (5) ice chiller; (6) heat exchanger; (7) water deflector ; (8) water tank; (9) water pump; (10) fibreglass over insulated timber frame; (11) & (12) product pallets; (13) wooden pallet; (14) plastic tarpaulin

loss. Wilting and shrivelling seriously damage the appearance of produce and detracts from customer appeal. With table grapes, stem browning can occur at less than 2% of weight loss.

Pre-cooling air humidity in the range of 80% to 100% relative humidity has a negligible effect on moisture loss from the produce (Thompson *et al.*, 1998). Most of the vapour pressure difference (VPD) between the cooling air and the product is a result of the warm product, not the humidity of the cooling air.

Until recently most of the systems used to cool perishable products employed the conventional finned tube evaporator which has limitations when used for storage of produce with high water content (Farrimond *et al.*, 1979). This kind of evaporator produces cooled air of low relative humidity, passing over the fresh produce extracting moisture and causing weight loss, shrivelling, softening, loss of colour, shattering and shortened storage life.

Since finned coil evaporators run at an evaporating temperature below freezing point, it must be periodically defrosted. The defrosting process requires energy and causes the cold room temperature to rise temporarily and/or interrupt the pre-cooling process, accelerating produce spoilage (Helsen & Willmott, 1990).

Wet deck air cooling is a system where ice cold water is brought into intimate contact with recirculating air within a cooler. This system uses a refrigerated coil or chiller so that the cooled air stream over the produce can be humidified to nearly 100% relative humidity or, in other words, virtually saturated with water vapour. The cool, humid air is distributed throughout the cold store under controlled conditions (temperate and air speed) to maintain the required pre-cooling or storage environment for the fresh produce. The National Institute of Agricultural Engineering developed that system in the 1970s (Macleod-Smith *et al.*, 1995).

1.1. Unit description

As shown in *Fig. 1*, the cooler consists of an air moving system (fan) which is usually sized in terms of airflow rate and static head pressure according to the type and amount of product to be pre-cooled. The water distribution system includes a water pump with its piping, water spray header and water collection sump. A fill pack is used to create a large surface of heat transfer surface to exchange heat with the pumped cold water effectively. Various type of packing material is being used to produce good contact between air and water in a limited space. An arrangement of horizontally-stretched plastic filaments is widely used. Therefore the cold water is 'filmed' over the extended surface of the fill pack, thus exposing the air to a large surface area of cold water, which achieve highly efficient cooling and humidifying of the air (Geeson, 1989).

For the low temperature applications (3-4°C), an optimum refrigeration plant working with either direct expansion or secondary system is used to supply the required cooling capacity of an ice builder or ice bank (immersion type evaporative coil) which is the key element on the refrigeration unit. Using the optimum expansion valve with the optimum evaporating temperature, ice accumulates over the extended surface plate (evaporative coil) which is submerged in a tank of agitated water.

Cooling is supplied in the form of ice water pumped from the ice water tank, which works as thermal storage unit to the top of the fill pack heat transfer surface (cooling tower). The ice forms on the evaporative coil when the refrigeration load is light and melt when the load goes up. Since the refrigeration system can operate continuously, it requires only a fraction of the capacity that would be needed if it were required to cool an entire day's production during a few hours on a hot day. To reduce energy cost and capital cost as well, the ice can also be built at night or when there is no load. It means that the size of the refrigeration system does not have to match the peak load requirement. The water must be circulated in the tank by a

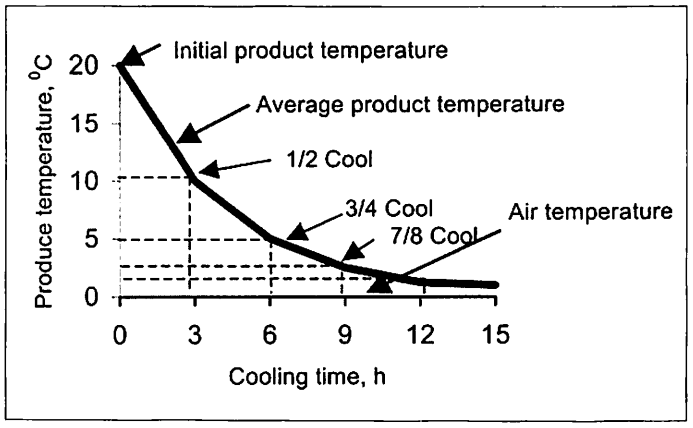


Fig. 2 Typical temperature pattern for produce cooling

propeller or agitated with air to melt ice evenly. As an alternative arrangement, the water flow over the refrigerated coil may produce a good heat transfer exchange to melt the accumulated ice. The blown up air cools down to the desired temperature.

The air, passing through the fill pack, dehydrates only slightly because of the small temperature difference between the air and the cold water. The air moving upward in the tower is brought to within as degree or less of the temperature of the water supply. Droplets of moisture, which can cause damage for the product, are usually stripped from the air stream by using mist eliminators manufactured from wood-slat or plastic demisters. The air leaves the cooler at temperatures as low as 1.5 to 2°C and relative humidity as high as 95-98%. Warmed water falls into a collection basin where it is pumped evenly over the length of the evaporative coil in the water/ice tank to maintain a uniform melting and build up of ice on the plates of the evaporative coil. To prevent any possibility of the cross contamination caused by decay organisms being picked up by the returned moist air passing the pre-cooled produce, chlorination system using must be applied.

The pre-cooling process is achieved by directing the air from the cooling tower through a positive ventilation system. The tunnel method is the most applied technique where pallet loads of produce are placed in two lanes on either side of open channel. A tarpaulin is placed over the product, covering the open channel which is usually called air return channel, and a fan removes air from the channel, forcing air through the packed product. The warmed air is directed to cooling tower where it recooled and recirculated again to the product.

1.2. Objectives

The objectives of the current study were to:

(1) analyse the application of the wet deck fast cooling systems in Egypt and describe its theory and the technical aspects of that systems;

(2) evaluate the performance of wet deck fast cooling systems adapted by the Egyptians exporters; and

(3) provide recommendations for the better running of those systems.

2. Materials and methods

Average temperature of the product being pre-cooled is represented by the curve shown in *Fig. 2*. The rate of temperature decreasing is related the temperature difference between the product and the air temperature of the pre-cooler and the air velocity through and around the product as well as the required adequate ventilation of the container used during the pre-cooling process. The rate of temperature drop per hour is fast at the beginning of cooling and slows as the product close to the final temperature (Gaffney & Baird, 1977).

The cooling curve in *Fig. 2* is expressed in an exponential pattern according to following form:

$$t = t_o + (t_1 - t_o)e^{-(\frac{hA}{Mc})\theta} \quad \text{.....(1)}$$

where: t is the temperature of the product at any given time in °C; t_o is the temperature of the surrounding air in °C; t_1 is the initial temperature of the produce in °C; θ is the elapsed time to reach temperature t in h; h is the heat transfer coefficient between produce and cooling air in W/m²K; A is the surface area of the produce in m²; M is the total mass of the produce in kg; and c is the specific heat of the produce in J/kg K.

The term hA/Mc, which includes the thermal properties of the produce, is a constant for the applied temperature range, depending on the heat capacity of the produce and the heat convection to its surroundings, and is often called the cooling coefficient, and denoted by the letter C. Thus, Eqn (1) can be transformed as follows:

$$\theta = \frac{-1}{C} \ln \frac{t - t_o}{t_1 - t_o} \quad \text{.....(2)}$$

The cooling coefficient C is a convenient measure of the characteristics of the cooling system and is easily calculated. If the surrounding temperature of the cold air is constant and the gradient of the temperature within the produce is negligible, a plot of temperature ratio versus time on a semi log graph ll yields a straight line with the intercept on the temperature ratio axis being equal to 1 at time zero and the slope of the line equal to C.

2.1. Calculation of half cooling time and seven-eighth cooling times

The pre-cooling process is often approximated with the concept of half cooling time, which is mathematically related to the cooling coefficient and more easily visualised. Half cooling time is the time required for the product temperature to drop half the difference between the initial temperature of the product and the temperature of the surrounding cold air and is denoted by the letter z.

According to the typical shape of the exponential curve (*Fig. 2*), after a second 'half cooling time' the temperature difference is again reduced to half. After three 'half cooling times', the difference becomes only 1/8th of the initial difference, and that is called *'seven-eighth cooling time'* which is the time required to cool the product through seven-eighths of the initial difference between the product and the coolant temperature:

$$z = \frac{-1}{C} \ln 0.5 = \frac{-\theta \ln 0.5}{\ln(\frac{t_2 - t_o}{t_1 - t_o})} \quad \text{.....(3)}$$

The result of the above is that the cooling formula can be solved once the 'half cooling time' for the specific product is known.

2.2. Cooling load calculations

The actual refrigeration capacity needed for cooling the two pallet load is calculated using the following formulae (Debney *et al.*, 1980):

Peak product refrigeration load in W =

$$\frac{\text{product wt in kg X temp. diff. in °C X 1.28}}{\text{seven-eighths cooling time in h}}$$

where the temperature difference is between the temperature of the product to be cooled and that of the thermostatically controlled room.

In a reasonably airtight, well insulated cooler used for rapid forced-air cooling, above 80% of the total refrigeration capacity is available for cooling the product (Thompson *et al.*, 1998). The remaining 20% is needed to cope with extraneous heat load. An estimate of the total refrigeration capacity required can be given by the following equation according to (Debney *et al.*, 1980):

Total refrigeration load =

product refrigeration load x 5/4

In another actual study for energy accounting of two forced-air coolers, Thompson and Chen (1988) indicated that only 47% of the refrigeration energy is being used for product cooling. The rest was used for removing heat from fans (37%), propane forklifts (8%), heat conduction through out the exterior cooler surfaces and through air infiltration (7%), and heat from miscellaneous sources such as lights and workers.

Since all selected coolers have been built using the conventional way of insulation, an extra 15 to 20% of the total heat load is added as a safety factor.

Table 1 The evaporative temperature and the available cooling capacity

	Packhouse No.1	*Packhouse No.2*	*Packhouse No3*
Ambient temperature, °C	43	43	43
Design evaporating temperature, °C	-5	-5	-5
Model number	Copland 4DJ3-3000-TSK-200	Copland D3DS-1500	Copland D3DS-1500
Catalogue cooling capacity, kW	49.5	29.5	29.5

Table 2 Refrigeration energy distribution of the selected systems

	Packhouse No.1	*Packhouse No.2*	*Packhouse No.3*
Initial temperature, °C	26	28	29
Desired final temperature, °C	4	4	4
Room temperature, °C	2	2	2
Calc. total refrigeration load, kW	20.4	22.1	23.0
Total airflow rate, m^3/s	5.19	2.36	2.36
Available cooling capacity, kW	49.5	29.5	29.5

2.3. Description of the selected packhouses

Three different wet deck systems are being run by the main pioneer exporters of table grapes from Egypt used for data collection for the current study. The table grapes were specified as the primary product for export from all these packhouses.

The first facility for packing table grapes is located on South Tahrir area and consists of six cold storage rooms and two typical wet deck system utilising semi-hermetic, R22, air cold condensing units.

The second company is located off the Cairo desert road 75 km from Alexandria. The facility consists of five wet deck style pre-cooling rooms, each with a physical capacity to pre-cool 4-6 pallets of table grapes. Semi-hermetic, R-22, air cold condensing units are used.

The third facility is located in El-Giza near the desert road; and has three typical wet deck systems with three small cold rooms. The refrigeration equipment utilised small commercial, R-22, semi-hermetic air-cooled condensing units.

All the data collected for this study was taken during the actual practices of the export season for all the three mentioned station. Seven-eighth cooling time (or cooling rates), the pressure drop across the pre-cooled pallets, and the level of relative humidity were the parameters used to judge the performance of the evaluated systems.

2.4. Pallets configuration

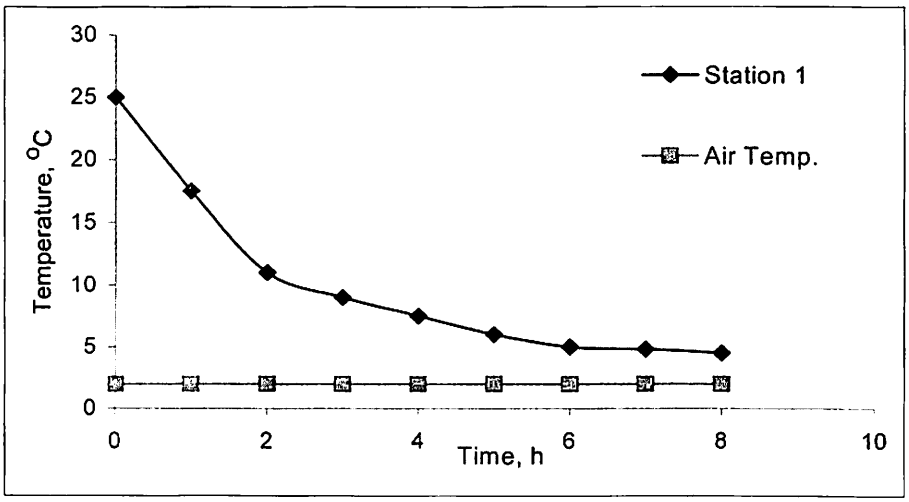
Four pallet loads of table grapes (Thompson seedless) were placed in two lanes (two pallets per each lane) on either side of each pre-cooling tunnel. The pallets were placed over a wooden base (1.0 m by 1.2 m and 1.0 m height) which was wrapped with plastic sheets to prevent any air bypass underneath the pallets. Polyurethane foam, 5 cm thick, was glued onto wooden boards and placed against the pallets to block any openings between the pallets and the plenum. The pallet preparation was similar on each side and consists of 144 cartons (5 kg per carton). Each box had an opening area of 5% from two sides (long walls) and 3% from underneath. The grape boxes were packed with sulphur dioxide pads to fumigate the grapes along with the plastic bag and liner. Each 500 g sample of grapes were packed into a sleeve bag, which had holes to allow air movement and prevent formation of condensation. The sleeve was placed in the boxes inside the perforated plastic liner to maintain moisture and SO_2 inside box. A corrugated cushioning pad was placed in the box first and the bag of grapes placed on it. The SO_2 pad was placed on the top of the grapes after packing and box closed. Clipped corners on the corrugated box were used in addition to strapping the boxes in order to reduce stacking stability as common practices for the shipment of the grapes. The outside dimensions for the lidded, corrugated grape container were 0.55 m long by 0.3 m wide by 0.15 cm high. The side vent of each carton was aligned with the side vent of the adjustment carton or the end vent with the end vent of the adjacent carton.

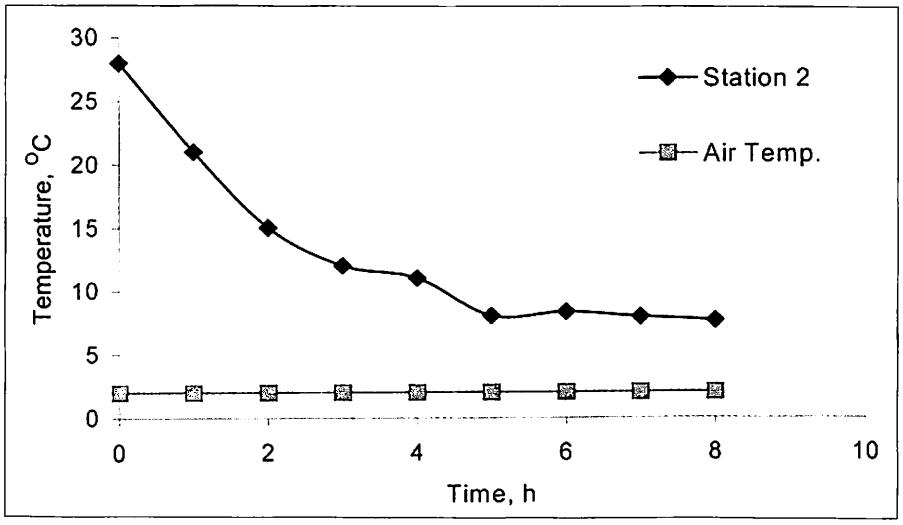
2.5. Description of systems refrigeration energy

The evaporative temperature for each system and its cooling capacity were documented through the model number and the catalogue data for each pre-cooling system and are shown in Table 1. The estimated refrigeration capacity using the above mentioned formula results in a 20-23 kW refrigeration capacity for 8 hours of seven-eighths cooling time for sea shipment of table grapes with 26-29 °C initial temperature and 0°C desired final temperature. Table 2 summarises the technical description of the systems.

2.6. Temperature measurements

Pre-cooling operations are usually managed on the basis of the warmest product in the process. Six thermocouples were placed inside the warmest container on each pallet, which





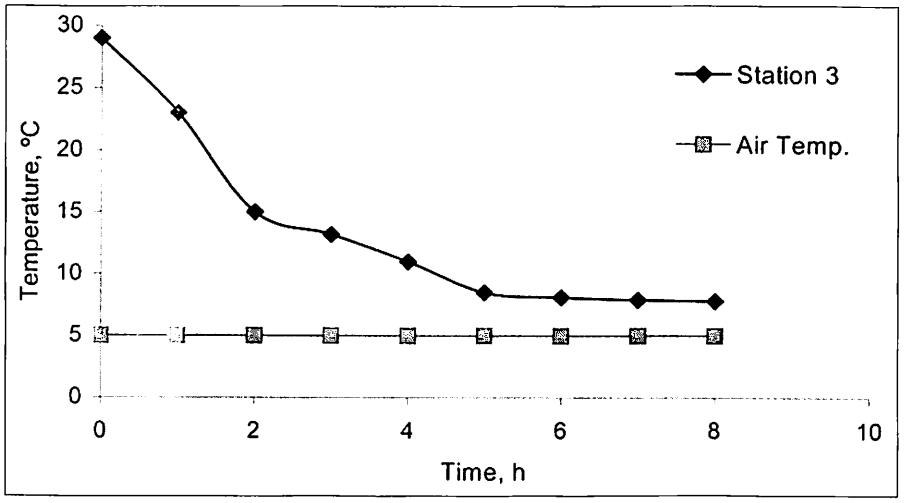


Fig. 3 Temperature response curves for stations No. 1, No. 2 and No. 3

is the one located farthest to the fan, near the air-return channel. The thermocouples were inserted 10 mm into the stem end of the berry. Another thermocouple was suspended on the middle of the tunnel to monitor the temperature of the returned air. The temperature of the supplied air was recorded via another thermocouple placed next to the air outlet of each system. Readings of thermocouple were recorded at intervals of 30 minutes using a temperature logger.

2.7. Airflow rate and pressure drop measurements

The measuring of the pressure drop across the pallets illustrates the importance of sealing the opening in between and under the pallets. A U-tube manometer was used to monitor the pressure drop across the pallets. The pressure drop depended very much on the box type used. The corrugated boxes prepared for the sea shipment were considered poorly vented and needed a high static pressure fan to move the air through those boxes. The airflow rate required for such boxes should be at least 2 *l*/s kg.

3. Results and discussion

The cooling curves obtained for the three selected packhouses stations are as shown in *Fig. 3*. As expected the time required to cool down the grapes to the final temperature was faster with the first station rather than with the other two stations. In the first station; the cooling capacity, which was available, exceeded the calculated load to cover any losses are not accounted for or to overcome the heavy resistance due to the type packaging used. The designed room temperature of 2°C was reached throughout the pre-cooling cycle and helped very much to lower the average grape pallet temperature near to the desired temperature in an optimum seven-eighth cooling time. The required time to reach a temperature of 5°C was 6 h while the half-cooling time was 84 minutes. It took a seven eight cooling time of about 7 hours for the first station to reach 4.8°C.

The resulting temperatures obtained for the three packhouses were used to produce the cooling coefficient *C* by calculating the gradient on a semi-logarithmic graph of log temperature *versus* time. The value of *C* is a characteristic of the cooling system and can be used to predict the cooling rate under the same conditions.

With 6 hours pre-cooling cycle; the temperature was decreased to 8.3°C and 8.2°C in the second and the third facility respectively. The reason for the slow cooling rate was due to the limited cooling capacity available and the limited air flow rate compared by the first packhouse. Another reason was the initial temperature which was 25°C for the first packhouse while it was 28°C and 29°C for the second and third packhouses.

The designed airflow rate for the different systems is another reason for the variation of the cooling rate obtained. The higher the airflow rates for a selected system the faster the cooling rate.

The values of pressure drop across the pallets are shown in Table 3. The pressure drop values should be always associated by the flow rate used since it varies

Table 3 The cooling coefficient values and the obtained pressure drop for the various stations

	First station	*Second station*	*Third station*
Average cooling coeff.	-0.0979	-0.0992	-0.103
Pressure drop, mm [H_2O]	40	25	24
Relative humidity, %	92	87	85

according to the flow rate and also according to the type of package used. The vented area and the interior packaging materials also influence the pressure drop.

The type of package used was a heavy duty since the intended method of transportation was the sea shipment. Most of the wet cooling systems installed in Egypt are 6 years old and more. They were not designed to cool down the grapes to the optimum temperature suitable for the sea shipment, which is –0.5°C and as mentioned before the type of sea shipment packaging were not accounted for in the design of the cooling load of the installed system.

Most of the water sprayed with the forced air to raise the level of relative humidity was in form of free water and not as a vapor gas. This free water used to weaken the strength of the carton and it was impossible for this carton to stand the required stacking height for the sea shipment containers. A chlorinated system is recommend to prevent any possibility of cross contamination, non-of the installed wet deck in Egypt are treating its water.

Neither of the selected systems uses a variable-frequency motor speed controller to vary the airflow rate according to the pulp temperature of the produce being cooled. The use of a variable-frequency motor speed controller will allow for the pre-cooling system to work as a cold storage by regulating the fan speed according the product being stored.

4. Conclusion

It is shown through the current evaluation that the minimum temperature, which can be achieved through a wet deck, is about 4°C to 5°C maximum. Most of the exported fruits out of Egypt needs about 0°C including grapes and strawberries. To have a successful sea-shipping process; to protect the product from a long time voyages and to overcome any unexpected delays might happen; all precautions should be considered. The first step in a good cold chain program is to decrease the temperature of the shipped product to the lowest feasible recommended temperature in order to extend the shelf life as long as possible and to maintain its quality. Therefore most of the wet deck systems are not suitable to provide the requirements of the new and the most feasible way of shipping.

With the wet deck system the selected setting temperature will never allow the freezing of the product at the normal operating conditions. The reason for that was to avoid any freezing of the sprayed water with the forced air.

The system is considered optimum for commodities, which need moderate pre-cooling temperatures such green beans; peach, and mango. The system provides a high level of relative humidity, which is usually reflected as minimum weight loss and excellent freshness appearance.

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Environment Award for Engineers 2000

Morrison Construction Ltd was this year's overall winner of the Environment Award for Engineers, sponsored by Lloyd's Register, for their 'Robin Hood's Bay scheme'.

Between September 1999 and June 2000, Morrison Construction Ltd undertook a £4 million scheme for Yorkshire PLC to clean up the sea around Robin Hood's Bay. The scheme diverted the raw sewage that discharged directly into the sea and pumped it to a treatment works in Whitby.

The client designed scheme involved three pumping stations, approximately 4 km of pumped rising and approximately 4 km of gravity sewer. This scheme had one of the pumping stations located on the sea front adjacent to a structure known as the 'Quarterdeck' in front of a cliff face which is unstable due to erosion.

The contruction team submitted an alternative scheme locating the foreshore pumping station inland to a more stable location. A pipe-jacket tunnel was then constructed out to the beach to pick up existing sewage flows from the long sea out-fall. This had several environmental benefits, the major ones being that:

1. nearly all construction traffic was taken out of the centre of the picturesque village reducing noise, dust and vibration pollution;
2. construction traffic was reduced from affecting several listed buildings in the village that had little if any foundation; and
3. nearly all the work on the foreshore, a Site of Special Scientific Interest was removed.

The completed works provide a solution to the disposal of raw sewage at sea with a financial saving to the client of nearly £1 million over the original client proposed scheme.

Affordable tillage and drilling combination from Lemken

Norfolk based Tri-Ag has introduced a non-powered 3.0 m minimal tillage drill combination based upon the new Lemken Saphir box drill and new Lemken Quartz cultivator. The combination is offered as high performance, but economically priced alternative to traditional power harrow drill and is purpose designed to fit in with reduced tillage operations.

The Quartz cultivator, which like the Saphir drill is available as an independent unit, is offered with a choice of tines and following rollers. This is to enable it to be specified to meet user requirements.

Choices include Lemken Gamma spring tines with shares in banks of two- or three-rows or duck foot tines in two-row configuration only. A levelling bar follows the tines, and is adjustable to work either as a track and clod eliminator on light soils or as a conventional levelling bar on heavier ground.

Completing the cultivator specification is a choice crumble bar or toothed packer. All three working elements can be adjusted separately without tools via rust free setting screws.

Moving on to the drill, the way in which it is mounted to the cultivator differs from standard practice. Normally, drills are rigidly mounted either directly or via a three-point type linkage to the power harrow or cultivator. Lemken have developed a pivot system for the Saphir Quartz combination that not only enables the drill to move a full 50 cm forwards as it is raised but also completely lifts the drill coulters and metering wheel out of work.

The feature has two benefits. Firstly, in transport and turning at the headland, the pivot system moves the drill's centre of gravity forward and reduces the need for excess front ballast on the tractor. Secondly, the coulters and drill metering wheel are raised completely clear of work, enabling the cultivator element to be used independently. This is of particular use when doing a blink cultivator pass before drilling the headland.

The drill shares the same Vario-Plus metering system as used in the highly regarded Solitair pneumatic drills. Renowned for its accuracy across seed types of all sizes, the Vario-Plus metering unit combines ease of setting up with proven and reliable performance.

A low profile seed hopper of 800 litres capacity is standard, with hopper extensions available as an option. To make manual filling faster and easier, a 500 mm platform with access steps from both ends is also fitted.

Double disc coulters, with both central and individually adjustable pressure settings, enable the Saphir drill to work in trashy conditions. Accurate placement is a key design feature, each coulter having individual depth wheels that also firm the soil around the seed to promote fast and even germination.

Other drill features include the proven LH 1600 on-board computer monitor. This easy to operate unit is used to detail workrate, set the tramlines, check seed rate calibration and monitor other functions.

'Minimum tillage is a concept that has gained tremendous impetus over the past couple of seasons' says Lemken Tri-Ag managing director Mervyn Hutton. 'For a number of farmers, however, the cost of entering into this type of regime can be prohibitive. The Saphir Quartz combination comprises proven elements from existing Lemken products but does not have the price normally associated with a premium quality product.'

A 3.0 m Saphir Quartz combination with 800 litre hopper, 24 drill coulters, two rows of duckfoot tines and crumble roll packer weighs 1700 kg empty and is priced from £11,300.

A solo Saphir drill is available in 2.50, 3.00 and 4.00 m widths with prices from £8438, £9526 and £12,337 respectively. Quartz rigid cultivators are also available in the same working widths and are priced from £1388, £1657,and £1993.

Contact: **Mervyn Hutton, Tri-Ag Limited, Eleven Mile Lane, Suton, Wymondham, Norfolk, NR18 9LR. Tel: 01953 605151**

Instant hot water at any dead leg or hose

Most farmers, particularly livestock farmers must sometimes wish to have instant hot water at the point of use when and wherever it's needed. Not only for speed and convenience but also to reduce water wastage and to conserve on energy bills.

Now at least there is a solution in the form of a brand new product called the 'Flowmizer' from Rayflow Developments. The Flowmizer is a compact 28 x 13 x 13 cm, easy to install (into a new or existing hot water system) to produce instant hot water at any deadleg, including hoses. Incidentally in doing so, is a frost protector in its own right and will therefore reduce the need for insulation on vulnerable pipes.

The Flowmizer can also be used for Heat Tracing, Destratification and will reduce the risk of Legionnaire's disease by maintaining the temperature within the pipe above legionnaire's disease breeding temperature.

In a normal domestic situation alone, it is estimated that the Flowmizer will save between 38-45,000 *l* of water per annum and obviously it will be far greater on working farms. The greater the water savings also relate directly to greater savings on energy bills and possibly increase the time between emptying effluent tanks, which all adds up to a short payback period.

Contact: **John Howe, Rayflow Developments, 27 Riverhead Close, St. James Mews, Southsea, Portsmouth, Hants, PO4 8SN. Tel: 02392 297427 E-mail: office@rayflow.fsbusiness.co.uk**

Programmable joystick with a focus on ergonomics

With the aid of both ergonomists and users, Morse Controls has brought out a new type of programmable joystick that will enable more ergonomic operation of equipment, such as industrial vehicles.

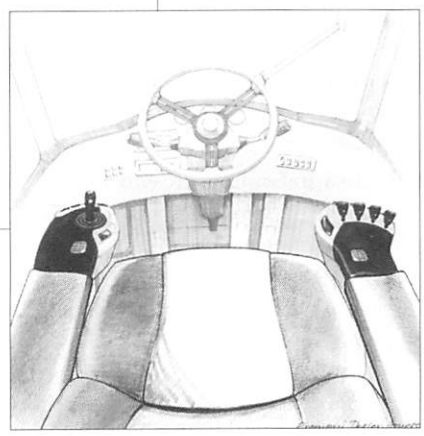
Ergonomic shape and programmability are the principal features in this new electronic joystick from Morse Controls

The new joystick has all the necessary electronics built in, so that it can, for example, be connected to a CAN databus via its multi-pole connector. In addition, pulsewidth modulated (PWM) signals or analogue control voltages can be obtained from the joystick, for direct control of solenoid valves.

The unit's six background-lit buttons are programmable via a serial RS-232 interface and a Windows-based program. This program permits all of the parameters and automatic functions to be supervised.

'The idea is that the designer shall be able to install the joystick in, for example, an armrest,' says Björn Hedlund, General Manager for Morse Controls in Sweden. This gives the joystick an optimal position when the control system is used frequently.

The joystick handgrip can be changed, and so the unit can be adapted to suit different applications and users. The wrist rests on a surface covered with material that according to the company provides firm support and a comfortable feeling even after many hours. 'It is vital that the joystick's design and shape prevent industrial injury and consequent time off sick,' says Jan Lindström, who is the Project Manager for development of the joystick. 'A modern joystick must also feel good to use.'



Typical applications for the new joystick is to control hydraulic equipment in various types of industrial vehicles, such as fork lift trucks, wheel loaders and agricultural tractors.

Contact: **Matthew Lee, Morse Controls Ltd, Christopher Martin Rd, Basildon, Essex, SS1 43ES. Tel: 01268 552861 E-mail: m.lee@morse-controls.co.uk Website: www.morse-controls.se**

John Deere's new telescopic handlers

John Deere's all new 3000 Series telescopic handlers made their European debut at the Royal Highland Show. Compared with previous models, the 3200 and 3400 feature a new frame and boom design, a new engine and transmission, new hydraulics and electrics, plus a new cab and operating platform.

Both models are driven by a John Deere PowerTech 4.5 litre 75 kW engine, mounted at the rear for stability and better service access. This high torque, fuel efficient engine is the same as that fitted to the John Deere 6410 tractor; it provides constant power over a wide operating range, and can generate an extra 2 kW power 'bulge' when it's needed. Fuel tank capacity is the largest on the market, at 200 litres, while fuel consumption is the lowest, at 200g/kWh.

The 3200 has a maximum lift capacity of 2.8 tonnes to the maximum lift height of 5.62 m, dropping to 1.5 tonnes at the maximum forward reach of 3.1 m. The 3400 has a maximum lift capacity of 3 tonnes to the maximum lift height of 7.12 m, or 1.3 tonnes at 3.87 m. Maximum cab height is 2.41 m on the 3200, fitted with 50 cm tyres, or 2.47 m on the 3400, fitted with 60 cm tyres.

Both models feature a four speed synchromesh torque converter transmission with forward/reverse shuttle and permanent four wheel drive, plus wet disc brakes front and rear. The handlers have a top road speed of 30 km/h (3200) or 34 km/h (3400).

The improved implement carrier features a patented cone type coupling system, and is available with floating 106 or 122 cm forks. It also accepts older John Deere 4000 Series and Matbro attachments. Other versatile options include a choice of clevis, automatic wagon and pick-up hitches, plus hydraulic or pneumatic trailer brakes and rear hydraulic services.

The handlers have three steering modes - front-wheel steering only, four-wheel steering and crab steer - and the 43° steering angle provides a tight turning radius of only 3.6 m on the 3400 model. Direct linkage control of the boom provides improved handling via the joystick, which is integrated within the control console on the driver's right hand side.

Open centre load sensing hydraulics are the same as fitted to the John Deere 6010 SE Series tractors. The system provides a high capacity of 107 *l*/min and simultaneous flow in all functions as standard, to ensure quick working cycles with no loss of performance.

The new tractor style quiet cab has a low step and wide body for easier access, a fully adjustable seat and a large glass area for maximum visibility, plus optional air conditioning. The steering column also tilts and telescopes to provide a more comfortable driving position, and easier cab entry and exit.

The engine hood can be removed in minutes without the use of tools, providing excellent service access on both sides of the machine. For extra safety, the hood covers both the turbocharger and the exhaust, and there are two front and two rear adjustable working lights as standard.

Prices of the new John Deere 3000 Series telescopic handlers are £34,973 for the 3200, available from September 2000, and £37,773 for the 3400, available from October, excluding VAT.

Contact: **Gordon Day, John Deere Ltd, Langar, Nottingham, NG13 9HT. Tel: 01949 860491**

Designing with timber to Eurocode 5

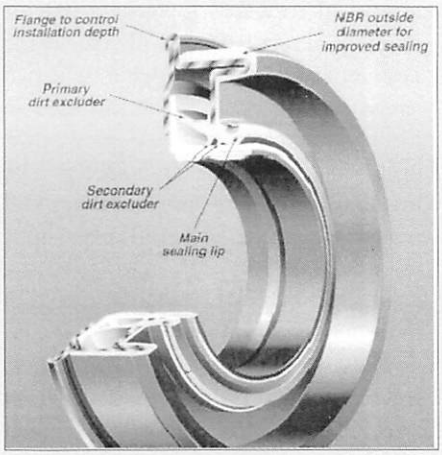
All the structural Eurocodes, including Eurocode 5 for timber, are based on 'limit states' design. For many structural materials this is already well established but timber has traditionally relied on the UK 'working stress' codes which are more prescriptive.

TRADA Technology has published a leaflet on the fundamentals of limit states design in timber structures which draws on the findings of recent research. TRADA says that a lack of understanding of the serviceability principles can lead to over-specification. If correctly applied, the Eurocode limit states approach opens up opportunities for more innovative design and the specification of new materials such as structural timber composites.

Serviceability limit states for timber buildings (6 pages A4) is available, priced £5.

Contact: **Trada Technology, Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire, HP14 4ND. Tel: 01494 563091 Website: www.tradatechnology.co.uk**

Keeps oil in, dirt out



Preventing leakage of lubricants inside the mechanism where they perform a useful function on heavy construction machinery is only part of the duty of an oil seal. It is equally important to keep water, dirt and other contaminants out.

Robeco International has the definitive solution in its new heavy duty seal, specially designed for situations where the air is thick with flying mud, concrete dust and various abrasive particles. Examples include axles on bulldozers, agricultural tractors, diggers and concrete mixers.

Active element of the NAK Type AO, AJ and AP shaft seal is a metal reinforced moulding of nitrile rubber on a steel core, coupled with a garter spring. It is a multi-lipped prelubricated seal used in conjunction with an integral wear sleeve. The innermost section remains stationary on the shaft, while the outer part rotates with the bearing cage.

Virtues of the construction include an ability to flex to allow for axial movement between shaft and housing, long service life with excellent exclusion of moisture and dust, and easy maintenance to suit conditions which might impose aggravated shaft wear.

The integral wear sleeve design gives easy installation plus reduced preparation processes in manufacturing costs on mating parts.

Contact: **Mike Worley, Robeco International Ltd, Rowley House, School Close, Chandlers Ford, Eastleigh, Hampshire, SO53 4BY. Tel: 023 8024 6999 E-mail: mike.worley@robeco.co.uk**

'Mumm' knows best when it comes to robots

As the champagne corks 'popped' the world-over in celebration of the Millennium, French champagne producers could rest easy knowing that there was plenty of bubbly to go round - thanks to the industry's forward thinking in installing ABB robots to improve production some years before.

A drive for better productivity has led to a 'cultural revolution' in the champagne industry with ABB robots now carrying out a wide range of previously labour intensive operations.

As early as 1994, Mumm (The Seagram Group) saw the considerable advantages of a productivity partnership with ABB, by integrating robots into its sediment removal operation, newly housed in a purpose-developed workshop.

'Bubbly' on its way thanks to ABB Robots

Mumm's robots have been such an unqualified success - doubling production, reducing maintenance and improving working conditions for employees - that the company has extended the robot area of operation, integrating them into packing and palletising as well.

The Jaquart co-operative is another producer benefitting from an ABB integrated package, initially installing an IRB 6400 series robot in its packing area.

Gilbert Bridoux responsible for Jaquart's production and purchasing said: 'Previously, this was a completely manual operation and involved three people plus a truck driver. Today it is only the truck driver who is still involved, and the three other people have been transferred to other jobs in the company.'

The ABB robot was chosen because of its capacity to adapt to a stock comprising 50,000 assorted pallets built-up over the years. With stock valued at 30 million francs, it was thus necessary to pair it with a flexible and versatile tool.

Arnaud François, in charge of maintenance and servicing at Louis Roederer, is also one of the robot 'converted'. Exchanging an ageing palletiser for a state-of-the-art IRB 4400 series robot, he has seen massive space savings and significantly reduced 'manual' input as the machine handles 500 cases (3000 bottles) per hour.

Over the last decade, while still preserving a timeless image of Gallic tradition, French champagne producers have driven flexible automation forward - gearing-up and transforming the industry into an efficient, productive, consumer-orientated business. ABB with its technical and business excellence, have been instrumental partners in helping the industry achieve its objectives.

Contact: **Jane Attwood, ABB Flexible Automation Limited, Auriga House, Precedent Drive, Rooksley, Milton Keynes, MK13 8PQ. Tel: 01908 350300 E-mail: jane.attwood@gb.abb.com**

Tomahawk 9090

A new machine, the Tomahawk 9090 has been added to the top end of Teagle's range of Bale Shredders and Silage Feeders.

The new unit is similar in concept to the award winning 8080 model, but it has a much larger cubic capacity. The 9090 will handle round or rectangular bales of silage, round or rectangular bales of straw, or up to 6 cubic metres of clamp silage. The 9090's capacity is ideal for customers wishing to feed large volumes of clamp silage and also bed down loose housing.

The increase in capacity over the 8080 model has been achieved by stretching the chassis by one metre and fitting deeper sides. The construction of the machine and the conveyor drive line have been generally beefed up to cope with the extra loading imposed by the weight of the silage.

The machine will hold two round bales or one full size Hesston. Two small format rectangular bales can often be loaded one on top of each other. The hydraulic tailgate allows bales to be self loaded if necessary.

The material to be dispensed is conveyed forwards towards a pair of horizontal cross beaters, which meter the crop into a two speed impeller. The two speed facility enables the machine to discharge silage alongside or blow straw up to 20 metres into wide sheds. The metered feed avoids power surges and permits the use of relatively small tractors.

The Tomahawk 9090 is available in three versions, standard side delivery, swivel Giraffe and twin chute models. Recommended retail prices are from £13,995 depending upon model and options.

The Tomahawk 9090 is British designed and built alongside the rest of the range in Teagle's modern UK factory.

Contact: **Teagle Machinery Ltd, Blackwater, Truro, Cornwall TR4 8HQ. Tel: 01872 560592. Fax: 01872 561166. e-mail: sales@teagle.co.uk**

Engine failure prevented by 'EngineGuard'

New to UK, the 'EngineGuard' engine protection system from Agriemach uses high-tech sensor technology to prevent engine failure caused by overheating. The two areas in engines most likely to cause overheating are, a reduction in oil pressure, and loss of cooling water in radiators. Either could result in serious and costly engine damage.

Using separate sensors, the system ensures both areas are continuously monitored. Should there be a loss of oil pressure, or the water level in radiators drop below a safe level, the relevant sensor will 'kick in' to activate both a warning light and a buzzer for 30 seconds duration, before shutting down the engine automatically.

By detecting and responding to excessive heat before serious problems arise, 'EngineGuard' has been successfully used by leading vehicle manufacturers for over 25 years and is recognised as the proven engine early warning / shut-down protection system that offers complete peace of mind.

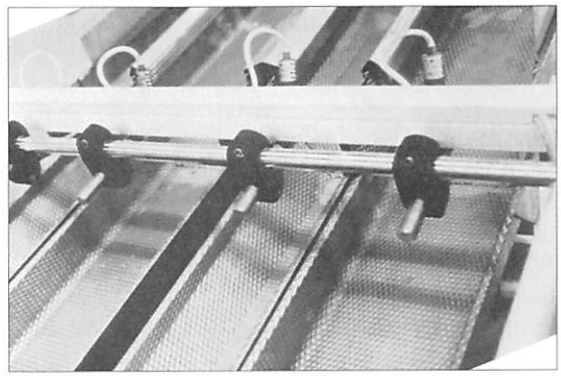
Different version 'EngineGuard' models are available to suit individual engine/fuel combinations for petrol, diesel, and propane. All diesel versions include an over-rule switch, and special models are recommended for use in hot climates. Each system comes complete with full fitting instructions, plus control unit, oil pressure sensor, water level sensor, warning light, and warning buzzer.

Vehicles successfully fitted with 'EngineGuard' include: cars, vans, trucks, buses, fire engines, and fork lifts, plus marine, off-road and stationary engines. There is also a mechanical system available which requires no electrical connections and is ideal for the petrochemical industry, or where electrics on engines are not permitted.

'Engine Guard' from Agriemach prevents engine failure caused by overheating due to loss of water or reduction in oil pressure.

Contact: **Agriemach Ltd, Wayfarers, Domewood, Copthorne, Crawley, West Sussex RH10 3HD. Tel: 01342 713743. Fax: 01342 719181. e-mail: agriemach@hotmail.com**

Rimex introduces the Maxislide™ collection



Textured finishes to improve sliding properties

Rimex Metals (UK) Ltd, part of the UK-based Rimex Group - producers of textured finishes on stainless steel and other metals - introduces MaxiSlide™, the latest addition to their collection of industrial finishes.

Specifically designed for conveyors and processing machinery, MaxiSlide's unique textured finish prevents components from sticking. 'Peaks' in pattern design reduce resistance making it easy to move everything from food to industrial components rapidly and efficiently down conveyor belts and through the entire production process.

Crafted from the highest quality stainless steel and other metals, Maxislide's three dimensional finishes protect both the product and equipment from damage and delay. The durable finish is scratch resistant and easy to clean. When MaxiSlide is used in conjunction with stainless steel, it provides an hygienic surface, making it ideal for food processing as well as other applications.

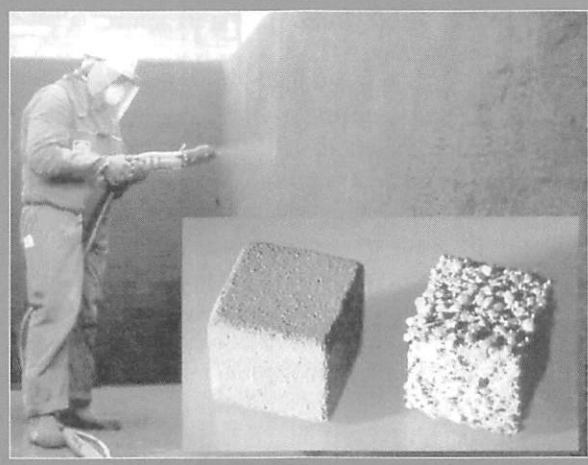
For more than 40 years, the Rimex Group has manufactured and delivered surface finishes on a range of metals suitable for engineering, industrial, architectural, retail, transport and product applications. With comprehensive manufacturing facilities in the UK, USA, Australia and South Africa; stocking and distribution companies in Germany, Ireland, France and Spain; and a global network of agents and distributors, the Rimex group has established itself as a world leader in the field of superior surface technology on metals and alloys.

Contact: **Rimex Metals, Aden Road, Ponders End, Enfield, Middlesex, EN3 7SU. Tel: 020 8804 0633 Website: www.rimexmetals.com**

Konusit overcomes concrete inadequacies

The inability of conventional concrete and mortar to protect against mineral and organic acid corrosion found in sewage treatment plants, has motivated Birmingham based manufacturer MC Building Chemicals to evolve two new specialist products - Konusit KK10 and Konusit KK30.

The two mineral silicate mortars have been developed to answer the need for materials that will withstand sulphuric acid corrosion, generated as a result of the gas zone that exists above the sewage and chemical level in septic towers, covered sludge containers, channels, chimneys, shafts and similar areas. In such hostile locations conventional concrete and mortar is not up to the task and is simply eaten away by the corrosive atmosphere.



Konusit KK10 protected concrete after acid attack (left); and unprotected concrete after acid attack (right)

Both Konusit KK10 and Konusit KK30 are based upon an amorphous silicate gel that combines good dimensional and spatial stability, as well as excellent adhesion to concrete, steel, cast iron and brickwork. Konusit KK10 is applied as a render and Konusit KK30 is used to reinstate flooring or other horizontal surfaces. Together, they are able to create a fully 'tanked-out' structure.

With the exception of hydrofluoric acid, they will resist all organic and inorganic acid attack. In addition, whilst being fully impermeable to liquids, both are able to tolerate vapour diffusion. The extremely versatile formulations also resist ageing, temperatures up to 570°C (KK10) and 750°C (KK30), anti-freeze and defrosting agents.

Konusit KK30 is extremely resistant to wear and tear and develops a compressive strength of 3.9 N/mm^2 in just 24 hours and 12 N/mm^2 after 28 days. Both materials are physiologically harmless and in order to facilitate traditional working techniques, have been formulated to allow spray and trowel application in conventional fashion.

The demands of such challenging corrosive environments are no longer a problem for MC Building Chemicals. Those responsible for the maintenance of plant in the water, sewage, chemical raw materials, food processing, paper and cellulose industries will welcome both materials.

Contact: **MC Building Chemicals, Unit 17, Stechford Trading Estate, Lyndon Road, Stechford, Birmingham B33 8BU. Tel: 0121 789 8333. Fax: 0121 789 8595.**

New CTS combines from John Deere

John Deere's CTS combine harvester has been developed further for the 2001 harvesting season, with the introduction of a new Hillmaster model, new composite styling, a larger fuel tank and improved lighting.

The 9780 CTS is available as a level land machine or in a Hillimaster version offering full harvesting performance on slopes up to 22%. This model is the only non-conventional combine on the market offering automatic self-levelling, which is electronically operated via the CAN BUS electrical system.

This gives faster reaction times than the mechanical system employed on John Deere's 2200 Series combines, and also provides an extra 4% tilting capability compared with the conventional Hillmaster models.

The new composite styling material is used on the machine's main side panels, cab side shields and the engine platform rear wall and access door. It is a self-supporting sheet moulded compound (SMC) polyester material that is flame retardant and allows large panels to be designed without any steel reinforcement, making it 25% lighter than the steel equivalent.

It is easier to clean, with a better surface finish than steel, and does not rust. Covering a total area of more than 21 m^2, this is the first extensive application of this type of composite material to the design of off-road equipment.

Capacity of the fuel tank has been increased from 570 to 700 litres, to guarantee a longer harvesting day without refuelling - around 14 to 15 hours non-stop at an average fuel consumption of 45 litres/hour.

The new optional service lights provide excellent visibility for service and maintenance during evening or night-time operation, or when the combine is stored away. In addition, the two road lights are now integrated into the centre of the cab roof fascia, rather than mounted underneath the cab.

Both of John Deere's new 9780 CTS combine models retain the new CommandTouch cab, with ergonomic controls, revised instrumentation and air suspension seat. The master control lever has an adjustable hand rest and convenient switch locations for the ContourMaster automatic header float and stubble height, unloading auger and 'quick stop' controls.

This lever is part of the CTC console, which is incorporated into the seat's armrest. The console provides fingertip control of a multitude of combine functions, with switches backlit for easy, safe operation at night. All settings are automatically displayed on the combine's InfoTrak monitor when adjustments are made.

The cab's corner post has three displays for all the main combine functions the header monitor, the VisionTrak performance monitor and the Infotrak function monitor. It also features the ContourMaster control display panel.

CTS combines feature John Deere's innovative cylinder tine separation system, which is at the heart of the machine's threshing design. In operation, a thin, uniform crop mat is delivered at a shallow angle to a traditional cylinder/concave area, where up to 90% of the crop is separated.

From here the crop moves quickly across an eight wing beater to two counter rotating tine cylinders that run the length of the combine, at right angles to the main cylinder and beater, with a total separation area of 2 m^2.

The 'pull and release' action of the CTS tine cylinders works with the centrifugal force to free any grain trapped in the straw as the crop mat moves towards the rear of the combine. The heavy duty tines comb gently through the crop, keeping the straw fluffed, not flattened. This helps to maintain a smooth flow of material even in wet conditions, and leads to faster, cleaner grain separation with fewer losses.

The CTS combine is equipped with a John Deere 8.1 litre PowerTech diesel engine, hydrostatic drive and a three speed transmission. The turbocharged six cylinder engine develops a rated 229 kW, or 248 kW maximum power under load at 2100 rpm.

This extra power is provided when the combine is working in more difficult conditions, such as a thick, moist or weedy crop. When unloading the massive 9500 litre grain tank, the engine produces a further power boost to 274 kW, which allows the tank to be emptied in two minutes on the move.

Basic price of the new John Deere 9780 CTS level land combine is £168,475 with a 6.7 m header, or £169,575 with a 7.6 m header, including ContourMaster and straw chopper as standard. Hillimaster versions cost £177,906 and £179,006 respectively.

New 'Contract hire calculator' software program

John Deere Credit has developed a new 'contract hire calculator' software program to help farmers and contractors calculate the precise cost of buying a combine on contract hire. By simply entering the relevant model number and preferred specification, the total invoice cost allowing for any part exchange, the payment period and the likely annual acreage to be harvested, the program immediately identifies the cost of the machine per acre. Full details are available from John Deere Credit on freephone 0800 592422.

Contact: **David Hart, John Deere Ltd, Tel: 01949 860491. Fax: 01949 860490.**

On site shredder is a stormer

The hungry machine which will digest anything green

A unique shredder is taking the local authority and landscape contracting markets by storm. Grass machinery specialists Burrows (GM) Ltd have been appointed main dealers for the Eliet range of shredders.

The processor works much the same way as a large food blender. The unique system, which has 24 reversible blades, drives at 3000 rpm and will digest virtually any vegetation. Shredding is handled - and recycled - on site providing a considerable cost saving for local authorities and landscape contractors.

Burrows' Sales Manager Mr Tony Beamish explained: 'The ability to shred on site is fast taking off. Large branches with a profusion of side shoots can easily be fed into the hopper. A problem for local authorities and landscape contractors has been the disposal of green waste which is both bulky and expensive to handle. Each year local authorities produce large quantities of prunings, hedge clippings and bulk debris which is far too much for any domestic shredder and is not rigid enough to go through a conventional chipper. Traditionally, much of this material has been disposed of in landfill sites but this practice is expensive due to haulage costs and the rapid decrease in available sites. The introduction of a new generation of shredding machines, which is capable of reducing the volume of green material, has opened up a new dimension for this type of waste disposal. Once shredded, the prunings and debris can either be left to compost or can provide border cover.' 'The work capability and usefulness of these shredders is second to none', he added.

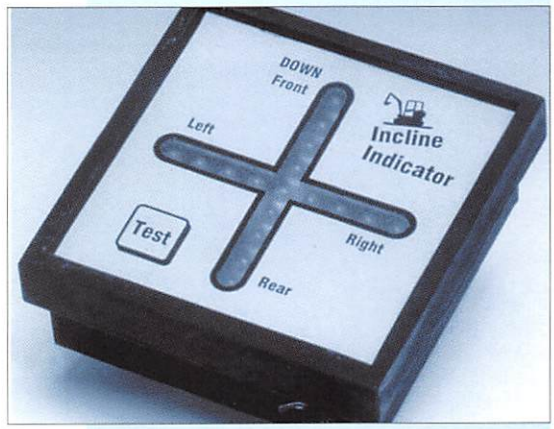
Contact: **Burrows (GM) Ltd. Tel: 01772 421778.**

Indicator aids excavator drivers who are inclined to go too far

Loughborough Projects has introduced the Incline Indicator System which is designed to give an easily understood warning of the extent and direction of tilt of a working or travelling excavator. A progressive visual display shows the angle of tilt and an audible alarm sounds if it exceeds a pre-set maximum.

During operation of the excavator the visual display continuously provides an indication of the angle of tilt, so that drivers can be sure they remain within safe working limits of inclination.

The indicator is easily fitted by service personnel. It cannot be modified by the machine driver and operates continuously as long as the ignition is on.



The new indicator from Loughborough Projects gives a visual display of the extent of tilt. An audible alarm sounds when the safe maximum is exceeded.

Contact: **Loughborough Projects Ltd, Swingbridge Road, Loughborough, Leicestershire LH11 5JB. Tel: 01509 262042. Fax: 01509 262517. e-mail: sales@loughboroughprojects.co.uk.**

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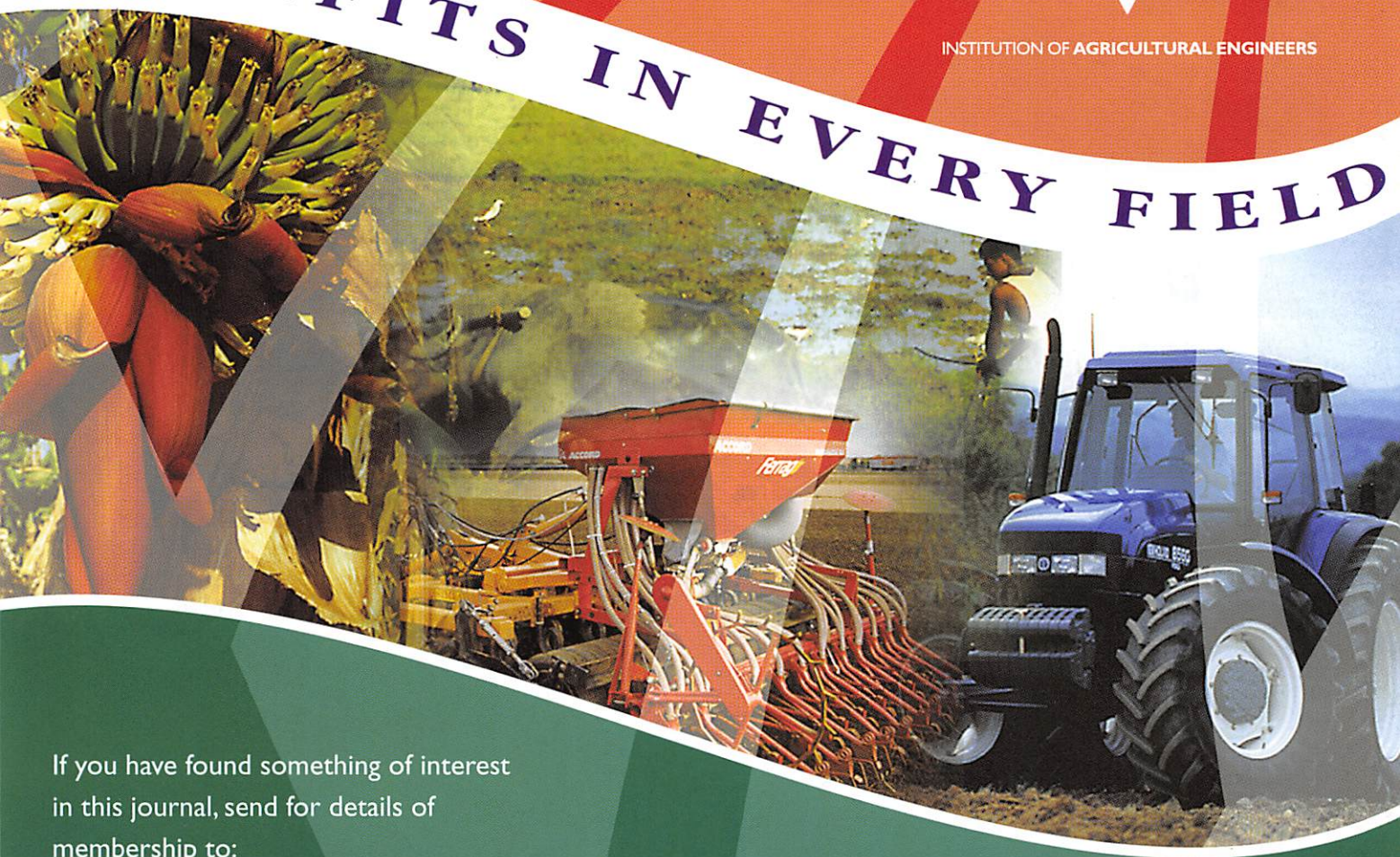

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