IAgrE Journal

# Landwards

Volume 51 No. 3 Autumn 1996

Agriculture • Forestry • Environment • Amenity

**Rhone Poulenc Agriculture &**
**Institution of Agricultural Engineers**

*in association with British Farmer*

convention

# Information Technology for Farmers

## A PRACTICAL GUIDE

**Silsoe College, Cranfield University**
**Wednesday, 4th December 1996**

The explosion in Information Technology is making new sources of information and resources available to farmers and their advisors. Computers are not just for doing accounts, or for working out the dairy rations; they are becoming a mainline tool in the running of the modern farm business.

The morning session, co-ordinated by Journalist and Broadcaster Marie Skinner, will dispel the mystique of e-mail, web browsers and service providers. Find out all you need, to get to the WWW pages of the Home Grown Cereals Authority for up-to-the-minute UK and world grain prices. Hear and see the developments underway with Farming On Line. Meet the people who are setting the pace in providing a focused approach to IT for farming in the UK.

During the breaks, there will be displays of the hardware and software you need to make full use of the new technology. Have hands on experience of the Information Super Highway - workshop sessions are available for you to look at web sites for yourself.

The afternoon will take you into Precision Farming, with Cranfield University explaining the use of your computer for satellite and yield mapping. Galaxy Precision AG Service will tell you how you can better target soil nutrient requirements within individual fields. Morley Research Station's MORIS database information system will be reviewed and future developments highlighted. All this helps better targeting of inputs to maximise farm profit and takes us into Integrated Crop Management. The practical farm use of these techniques will be reviewed by Lister Noble, Farm Manager for Rhone Poulenc Agriculture which has a comparison of ICM and conventional systems in progress at Boarded Barns Farm.

Register now. The fee is £65.00 plus VAT. Contact the Conference Secretary, Yvonne Miles, on 01525 861096 and send your cheque to:

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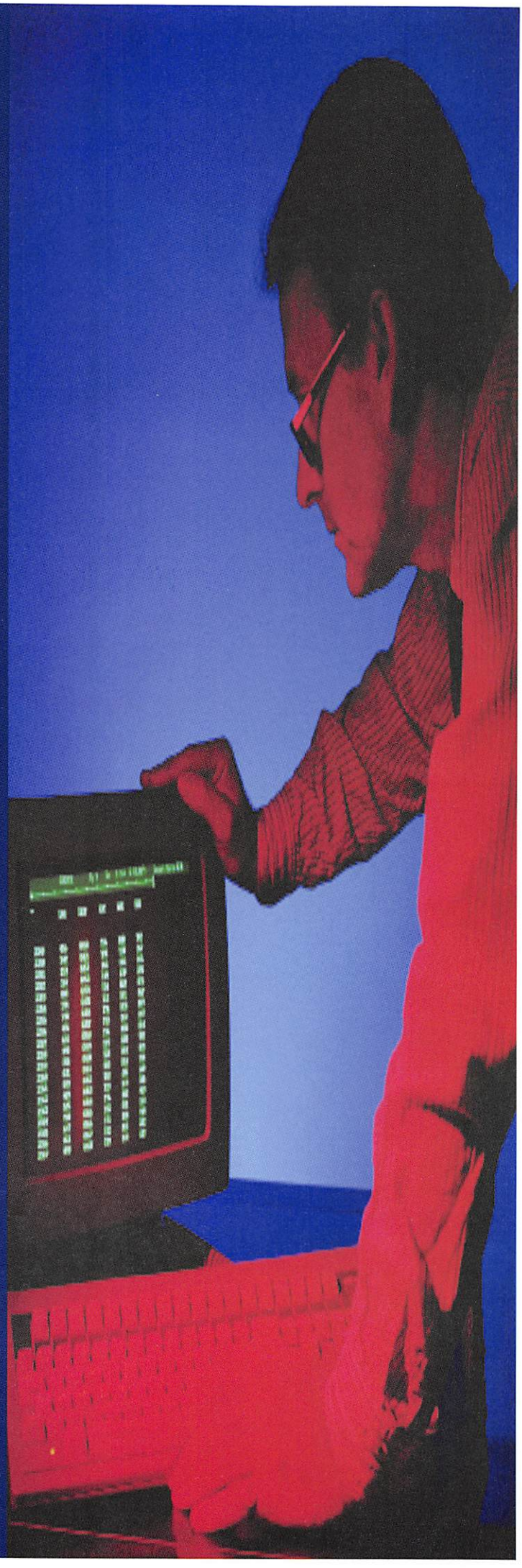

# Landwards

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

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**Front cover:** *Harvest* *(photo: Land Technology Ltd)*



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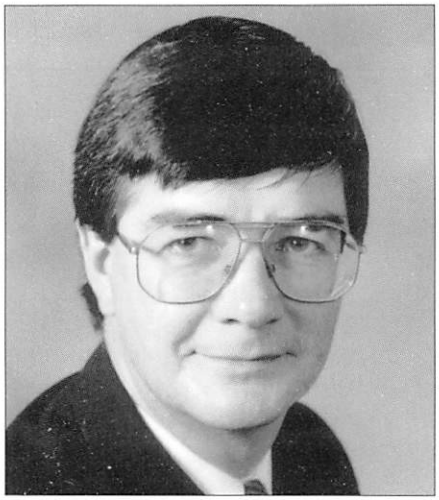


# Post-harvest, post-communism

**Alfred D Gracey**

Following an overview of factors influencing crop production in the former Soviet bloc, the author describes his recent grain storage project in Ukraine, and reflects on future development of agricultural production and processing as they emerge from the communist period.

## Introduction

Crop quality is closely connected to quality of life, through economic mechanisms and the application of science in agricultural production, processing and distribution. Provision of adequate supplies of nutritious food is a fundamental duty of a government to its citizens. The historical record shows that communism as a system of government is more seriously flawed than capitalism in fulfilling this duty.

Across eastern Europe and northern Asia the simplistic concepts of central planning have proved inadequate in coping with increasingly complicated technologies and sophisticated societies. Agricultural production and primary processing are intrinsically diverse, geographically extensive, and climatically variable. These characteristics alone make it clear that 19th Century theories of industrialisation, and early 20th Century practices of factory-based mass production, are not appropriate to agriculture. Yet Leninism and Stalinism dictated that the political and personal imperatives of a small group of power-holders should prevail over nature, geography and farmers. This power hunger expressed itself in unwieldy central planning of the economy.

Efficiency in use of natural resources is essential for accumulation of capital and improvement of life quality. To engineers the subordination of practical efficiency to arbitrary political theory is distressing. We express efficiency in many ways, for example - specific energy consumption, labour productivity, return on capital, comparative economic advantage, food quality and quantity output per unit of input. Against such criteria the performance of agricultural industries under communist regimes has lagged. Lack of clear distinction between "effectiveness" and "efficiency" in the generally rich Russian language is a small but significant symptom of how the concept of efficiency has been undervalued.

***This paper was presented at the IAgrE Annual Conference entitled: "Crop Quality - Post Harvest" and held at Writtle College, Chelmsford, on 2 April 1996.*** ***Alfred Gracey leads consultancy services for agricultural industries at L G Mouchel & Partners Ltd, West Hall, Parvis Road,West Byfleet, Surrey, KT14 6EZ. The Mouchel group provide a wide range of consultancy expertise throughout UK and internationally. Expertise includes grain handling, storage and processing; environmental sciences; engineering (civil, structural, industrial, power, geotechnical, water, marine, transportation, highways); and associated management consultancy.***

***The views expressed in this paper are the author's own and should not be attributed to Mouchel.***



**Table 1 Trends in real gross agricultural output in Central and Eastern Europe, 1989-1994 (Index 100 for 1989).**

| | *Real gross agricultural output (Index for 1989 =100)* | | | | |
|---|---|---|---|---|---|
| | ***1990*** | ***1991*** | ***1992*** | ***1993*** | ***1994*** |
| Slovenia | 104 | 101 | 90 | 98 | 118 |
| Romania | 97 | 98 | 85 | 95 | 102 |
| Poland | 95 | 94 | 83 | 85 | 78 |
| Czech R. | 98 | 90 | 79 | 78 | 73 |
| Slovak R. | 94 | 85 | 75 | 68 | 75 |
| Bulgaria | 95 | 94 | 83 | 68 | 70 |
| Hungary | 95 | 90 | 72 | 64 | 65 |
| Estonia | 88 | 83 | 68 | 63 | 56 |
| Lithuania | 91 | 86 | 67 | 60 | 48 |

***Source: European Commission, Agricultural situation and prospects in the CEEC, Summary Report, 1995.***

## Agricultural production in central and eastern Europe

Collapse of the communist system of economic central planning since 1990 has wrought great changes in agricultural production and processing in the newly independent states. Production of staple crops has fallen drastically *(see Tables 1, 2, 3)*, with severe consequences for food security and social cohesion.

Reforms stagger forward in attempts to build market-driven economies on the chaotic legacy of central planning. Performance is uneven across the countries, and across sectors within each country. Reasons include:

- diversity in local traditions of land ownership, in production and processing methods, and in distribution channels;
- shortage of capital to fund plant modernisation and energy-efficient technologies;
- a lack of widespread understanding of liberal market concepts, an indoctrinated suspicion of capitalism, and continuing state interference, all of which stifle enterprise (see *Table 4* for the effects of controlling the price of inputs while still controlling the price of outputs);
- widespread corruption and brutal power-seeking in high places; immature democratic mechanisms and unsophisticated electorates; lifetime habits of laziness and deceit engendered by the communist system.

As Milovan Djilas observed after a lifetime of observing communism at work, first as an active supporter of Marshall Tito and then as an influential dissident, "One cannot be a Communist and preserve an iota of one's personal integrity" (quoted by David Owen in Balkan Odessey, p36).

Conflicting advice and competing political agendas of western advisors has added to the confusion. For example, the European Communities' Common Agricultural Policy, with its host of farm subsidies and inbuilt protectionism, is a grossly imperfect and expensive model of how to organise a market-driven agricultural sector. Yet several countries are attempting to align their agricultural economies with the CAP, because they aspire to join the EU. This is doomed to failure because of its inherent cost, and because by the time they meet current EU criteria, the CAP will have had to be drastically reformed.

Western assistance has been hindered in post-communist countries by their:

- political instability
- lack of transparency in decision processes, and bureaucratic obstructionism
- unreliable production statistics and weak information systems
- rampant inflation and outmoded accounting systems
- immature infrastructure in commercial

**Table 2 Russia - production and consumption of selected produce.**

| *Produce* | *Production, Mt* | | *Change %* | *Recommended per capita consumption kg* |
|---|---|---|---|---|
| | *1990* | *1995* | | |
| Milk delivered to dairies | 39.8 | 15.5 | 39 | - |
| | *Per capita consumption, kg* | | | |
| Dairy Products | 386 | 240 | 62 | 390 |
| Meat | 75 | 51 | 68 | 78 |
| Fish | 20 | 10.7 | 54 | n/a |
| Bread | 119 | 135 | 113 | 119 |
| Potatoes | 106 | 117 | 110 | 117 |

***"The average Russian citizen consumes only 3/4 of the protein needed and only 1/2 of vitamins needed for healthy living". (V Sergeyev, Ministry of Agriculture, reported in East European Agriculture and Food, January 1996).***

**Table 3 Yield and total production of clean dry grain in Ukraine, 1986-1995.**

| | *Yield, t/ha* | *Production, Mt* |
|---|---|---|
| Av 1986-90 | 3.07 | 47.4 |
| 1990 | 3.51 | 51 |
| 1991 | 2.65 | 38.7 |
| 1992 | 2.79 | 38.5 |
| 1993 | 3.21 | 45.6 |
| 1994 | 2.68 | 35.5 |
| 1995 | - | 35.5 |

***Source: A M Spichak, Survey of Grain Storage Losses, 1995. TACIS GSIP 9302 Ukraine, LG Mouchel & Partners Ltd.***

**Table 4 Purchasing power of outputs versus inputs, 1995:1991, in Ukraine. For example, in 1995, it took 5 times more tonnes of wheat than in 1991 to purchase 1 tonne of diesel.**

| *Input* | *Relative output required, 1995 : 1991* | | | |
|---|---|---|---|---|
| | *Wheat* | *Milk* | *Beef* | *Pigmeat* |
| Tractor UM3 | 0.9 | 1.6 | 2.8 | 1.8 |
| Lorry GAZ | 1.5 | 2.9 | 3.7 | 4 |
| Harvester DOM | 3.7 | 6.9 | 10.5 | 8.4 |
| Petrol 1 tonne | 4 | 6.3 | 12.5 | 7.5 |
| Diesel 1 tonne | 5 | 8.5 | 14.7 | 10 |

***Source: AM Spichak, Parity exchange mechanism, in Survey of Grain Storage Losses, 1995. TACIS GSIP 9302 Ukraine, LG Mouchel & Partners Ltd..***

law, banking and property ownership
• language barriers and unexpected cultural differences.

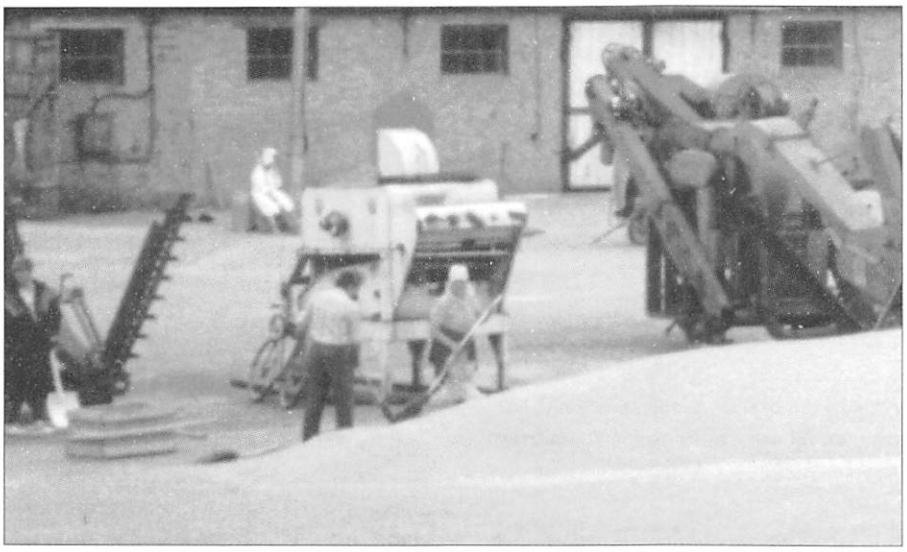
Whilst noting these specks of sawdust in another's eye, we would do well to reflect on the plank in our own. What is our response to:
• snouts in the trough when publicly-owned assets are privatised?
• criminal proceedings against businessmen, caused by ministerial evasion and economy with the truth?
• attempted annexation of a British province by a foreign republic?
• asset stripping, in the guise of financial efficiency?
• 40% of GNP in this country absorbed by the State?
• 2% of the UK's population controlling about 80% of its land area?

Great strides are being made in many ex-communist countries towards fuller democracy and reform of their economies. However, reform of agriculture has lagged, principally because land ownership and food security are emotive political issues in central and eastern Europe, with its history of famines linked to political upheavals and wars.

A distinction must be drawn between the system of government and the citizens taken as individuals. Many whom I have met are generous-hearted and will work hard when given direct incentives. Business relationships - as everywhere - depend on *trust*, and trust grows best from personal relationships. Patience and indirectness in early encounters is rewarded by later solidity in working together. Humility and sensitivity will come from reading up their history and literature.

## Grain storage in Ukraine

There are many western assistance projects in Ukraine. In addition to public utterances about economic reform, the agencies have sub-agendas on political and social reform. I sometimes felt that my Technical Assistance project was as much about "social engineering" as about agricultural engineering.



**Wheat being sun-dried and cleaned in a typical barnyard on an Ukraine collective farm.**

TACIS is a European Union (EU) programme which supports the development of economic and political links between the EU and the Newly Independent States and Mongolia. It seeks to help them in their transition to societies based on a market economy and democratic freedoms. TACIS does this through grants of money which pay for transfer of know-how from public and private organisations of the EU *(Table 5)*.

The **TACIS Grain Storage Improvement Project** in Ukraine ran from September 1994 till December 1995. The project was entrusted to international consultants L G Mouchel & Partners Ltd. Mouchel has been involved in the design and construction of more than 4 million tonnes of grain storage and milling capacity since the beginning of this century. Specialist contributions were made by ADAS, and the Greek firm PCK. The EU consultants worked closely with the Ukrainian Feed Research Institute. It will continue to promote the efficient techniques introduced to Ukrainian grain storage operators by the project. Other specialists were drawn from Mouchel-IRE Ltd, the Institute of Agrarian Economy and the Institute of Food Technology in Ukraine. No less than 9 members of this Institution served in the TACIS project, including 2 new recruits.

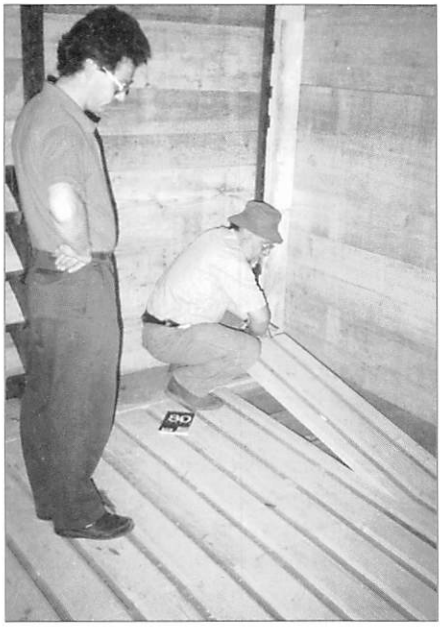
The aims of the Project were to identify practicable ways of reducing losses in stored grain, to demonstrate preservation techniques which should yield immediate improvement, and to identify longer-term improvements.

Our achievements included:
• demonstrations of drying, ensiling and chemical techniques for reducing losses during storage, and an assessment of their potential for wider application, with several hundred specialists from collective farms and the Ministry of Agriculture and Food Production attending the demonstrations;
• training on profitable management of agricultural enterprises, including preparation of investment proposals, for 30 farm managers;
• strengthening the Feed Research Institute's facilities, and clarifying its future

**Table 5 EU-TACIS Aid to Agriculture, 1990-1994.**

| | *Aid, million ECU* | | | | | *%* |
|---|---|---|---|---|---|---|
| | *1991* | *1992* | *1993* | *1994* | *Total* | |
| Russia | 50 | 21 | 13 | 16 | 100 | 47 |
| Ukraine | 7 | 12 | 11 | 5 | 25 | 16 |
| 14 Others | 23 | 27 | 8 | 21 | 79 | 37 |
| Total | 80 | 60 | 32 | 42 | 214 | |

strategy;
• widespread promotion of the improved techniques and dissemination of training information though literature and video packs, probably the first modern training aids for agriculture in the Ukrainian language;
• an assessment of the need and scope for improved storage facilities at farms, depots and mills;
• preliminary feasibility studies and stimulation of joint ventures;
• contributions to future policy formation in the grain sector.



**Ron Low and Bill Bailey inspect the Demonstration On-floor Dryer at the Fodder Research Institute's farm.**

## Loss survey results

In surveys of the 1994 and 1995 harvests, Mouchel's team discovered aggregate losses of 24% under average conditions and 50% under bad conditions for wheat and barley. For maize, which is mostly ensiled because it matures late in the year, losses are higher: 31% to 67%. *Table 6* shows the loss at each stage. This data is based on equivalent clean, dry grain. It describes straightforward *physical losses*. Nationwide, these signify more than one billion US dollars' worth of waste every year - grain which costs money to grow but which never gets to the food table or feed trough.

The economic value of *quality losses* is probably of similar magnitude. This covers degradation of seed or human food wheat to animal feed, destruction of nutrients, and accumulation of biotoxins and pest excreta.

A third type of loss is *energy inefficiency* in harvesting, transport, cleaning, drying and milling. Improvements were identified which enable savings of up to two-thirds of the energy currently spent in some operations. Reduction of energy consumption has a direct impact on the diesel and electricity bills of a farm or mill, and hence on their cash flow and profitability.

Each loss factor is significant enough to be tackled directly. The techniques promoted by the Mouchel team showed how grain conservation in Ukraine could be profitably improved. We did not have the remit or resources to tackle pre-harvest losses or secondary processing.

## Next steps

The following practical points summarise how and why grain harvesting, handling and storage should be improved. They merit consideration by governments and financing agencies, as well as by the managers of Ukraine's grain farms. They offer opportunities for business to British and other foreign firms. Similar needs and opportunities probably exist throughout the old Soviet Union.

**Better maintenance and low-cost upgrading of existing storage facilities is needed. This will reduce losses from weather, pests, and mechanical handling.**

On many farms the buildings used for grain storage are in poor condition. Rain enters through leaky roofs, ventilation apertures and doorways. Insect infestation is hard to control, and rodent control is impossible. Much higher standards of maintenance will yield a quick reward.

The common types of general-purpose sheds are inefficient storage because they utilise their covered space badly. Stronger walls would enable

**Table 6 Grain losses at collective farms in average and bad weather conditions, Ukraine.**

| *Wheat & barley grains* | | | *Maize - silage* | | |
|---|---|---|---|---|---|
| *Stage* | *Typical losses, t* | | *Typical losses, t* | | *Stage* |
| | *Average* | *Bad* | *Average* | *Bad* | |
| Clean dry grain in the field | (100) | (100) | (100) | (100) | Clean mature grain standing in field |
| Harvest delay | 5 | 11 | 10 | 30 | Harvest delay and harvesting |
| Harvesting | 10.5 | 27.6 | | | |
| Transport to yard | 1.7 | 2.5 | 1.8 | 2.8 | Transport |
| Cleaning | 0.8 | 0.5 | 1.8 | 1.3 | Milling at trench |
| Storage in yard | 2.5 | 3.9 | | | |
| Storage in barn | 3.2 | 4.9 | 17.3 | 32.9 | Ensiling |
| Total farm loss per 100 tonnes | **24** | **50** | **31** | **67** | Total farm loss per 100 tonnes |

***Source: P I Ross: An economic assessment of improved techniques and facilities for grain storage. TACIS GSIP 9302 Ukraine. LG Mouchel & Partners Ltd, 1994***

grain to be piled higher and the enclosed volume used more efficiently. Such modification would be highly cost-effective.

Grain cleaners are often badly adjusted and often overloaded. Simple adjustments by an attentive operator, and higher standards of mechanical maintenance, will prevent significant losses. Grain which is inadequately cleaned suffers accelerated spoilage during storage, and has a lower sales value.

Insufficient cleaning capacity often means that freshly harvested grain is stockpiled in open yards where it suffers damage from weather, birds and rodents. Much energy is wasted by passing grain through small scraper-type conveyor-aspirators in attempts to stop it heating and to remove light trash. Therefore more cleaners - of efficient designs which are manufactured in Ukraine - will pay off.

Simple repairs to leaky bodies on trucks and trailers, and using a canvas cover when carting grain from the field to the farmyard, will save losses worth 2% to 4% of the grain.

**Low-volume ventilation of stored grain should be used. It will control spoilage from heating, and reduce quantity and quality losses arising from fungi, insects and mites.**

All barns and silos which are currently used for storing grain longer than two months should be fitted with low-volume systems for ventilating the grain to keep it fresh and sweet. Operating staff will need to be trained in their use. In the relatively few systems already fitted, there is often scope for cost-effective improvements to airflow control and management practices.

**Bulk drying using ambient air offers lowest-cost drying and storage for grain with up to 22% moisture content.**

Installation of a bulk drying floor in an existing barn will cost one-tenth of the drying charge at a state depot and one-twentieth of the drying cost of a new high-temperature dryer. The project's analysis of climatic data for major grain-growing regions of Ukraine shows that there is widespread potential for this technique. Its energy consumption can be from less than 1 up to 2.5 megajoules per kilogram of water evaporated (compared with 3.5 MJ/kg in the best high-temperature dryers).

The project installed a demonstration unit at the farm of the Feed Research Institute. Many components of this system could be manufactured locally, apart from (initially) the automatic control equipment. A local firm is interested in adapting it to suit a range of needs, on large and small farms. It would welcome a British partner.

An effective way of spreading the bulk drying technique would be to construct a demonstration unit in every region, and use it as a training centre for the region's farms. It must be emphasised that management of this drying method is more sophisticated than pressing a few buttons. Operators need to thoroughly understand the drying process and its progress over time.

**High-temperature dryers fitted with fully-automatic control systems and better burners will slash energy costs. Licences should be negotiated to enable a quick start for local manufacture of new energy-efficient designs.**

Current designs of Ukrainian and Polish high-temperature dryers are thermally inefficient. Their running costs are too great for most farms and they stand idle, rusting away. The latest design (being developed by a Ukrainian Institute) has thermal efficiency of 5 to 6 MJ/kg. The rotary dryers seen on some farms are particularly inefficient, consuming 10 to 20 MJ/kg. Existing dryers should be fitted with modern pressure-jet burners which improve combustion efficiency, and with automatic control systems which prevent excessive drying. This will pay off handsomely in saved energy and sellable tonnage. Several efficient designs of western European dryer, which consume about 3.5 MJ/kg, are suitable for Ukrainian farms. These could be manufactured in Ukraine under licence.

**Chemical conservation is economic only for small quantities of wet feed grain that would otherwise spoil.**

For large quantities of grain, the cost of chemical treatment must fall to $0.4/tonne of barley, and $1/tonne of maize. The current import price for the most effective chemical (propionic acid) is $1.5/litre, duty paid, corresponding to treatment cost of more than $11/tonne of grain. There are no cost-effective local chemicals.

**Whole-crop maize silage must be short-chopped, tightly compressed, and thoroughly sealed with plastic sheet. Maize grain should be dried, not ensiled.**

Common losses of up to 40% in silage can be prevented readily. This will need better management, improved harvesting machines, and a supply of wide plastic sheeting. The financial return from plastic sheet alone is 250%. Wide sheeting currently has to be imported. Forage harvesters need to be fitted with kernel "cracker" devices.

**Minor modification and better maintenance of combine harvesters would halve their losses. Separate collection of straw will quadruple combine harvester performance.**

Harvesters cause losses of 11% to 31% because of design defects at the factory and maladjustment in the field - each equally to blame. Losses rise disproportionately in higher-yielding crops. Slow work rates, and lack of replacement parts to keep harvesters at work, means that the optimal harvesting period is doubled, incurring losses of 5% to 11%.

Combine harvesters are often used to chop and collect low-value straw. This slows their harvesting work rate by four-fifths. This practice cannot be justified.

**Thorough application of science-based feeding regimes for farm animals can raise their productivity by 50%.**

For example, feeding a cow with silage which contains 100% nutrient, instead of 40% "compost", allied with properly-designed supplementary compounds, could boost milk yields from less than 3500 litres to over 5000 litres per lactation. On-farm mill-and-mix units generally fail to provide balanced rations because of inadequate materials and neglect of formulation principles. There is a great need for supplements.

**An Agricultural Development and Advisory Network should be created, to promote a "Save Grain" campaign nation-wide.**

A Network, which unites all sources of expertise and other bodies interested in reducing grain losses, is necessary as the organisational vehicle

to carry forward a campaign to save grain. It could take many forms. It should be broad-based and commercially aware. A grain-focused Network could be the nucleus of a comprehensive, commercialised consultancy service which serves all parts of the agro-industrial sector. If suitably organised, it could attract foreign capital to supplement local resources.

### National strategy to reduce grain losses

A national strategy is needed because Ukraine cannot afford to lose one-third to one-half of the grain it grows, and because cost-effective technology is available to prevent those losses. A nation-wide campaign is a great challenge - and a great opportunity - to everyone concerned with the health of the population and the economic wealth of the nation. The strategy requires:

- clear vision, commitment, and leadership in policy-making, government and the business community;
- a dynamic market in agricultural produce and capital assets which will provide financial incentives for raising efficiency and justifying investment in farms to reward those who take risks and work hard;
- willingness by the international community to invest capital funds and technical assistance for the prosperity of Ukraine.

As one of the largest European states, the economic development of Ukraine is important to its neighbours in all four points of the compass.

### Future developments post-communism

Economic reform and industrial modernisation will take 10 to 20 years. A generation of fresh thinkers and creative entrepreneurs must be given time to arise.

To the cynic who once said "Diplomacy is but war waged by other means", I suggest that ethical business relations are the antidote to both diplomacy and warfare. I look forward to informal and formal joint ventures in business, financing, education, and research.

It will be healthy and stimulating for our profession as we expand our horizons eastwards and northwards, beyond that now-vanished Iron Curtain. As individuals we can build professional relationships and personal friendships through our common interest in R&D, education, manufacturing, consultancy and trading. As an Institution, we can stimulate professional productivity through the European Society of Agricultural Engineers and related bodies.

Let us set aside the macro-level confusion in politics and economics. Let us focus on building personal relationships were we have common interests:

- in practice of the technology which fascinates and delights us in agriculture
- in banishing the ogres of famine, malnutrition and drudgery
- in joint endeavour to grow our businesses and their businesses for mutual benefit
- to learn from each other, and to be inspired, as we breach the barriers.

## Health and safety 'Oscar' for 'Off Guard'

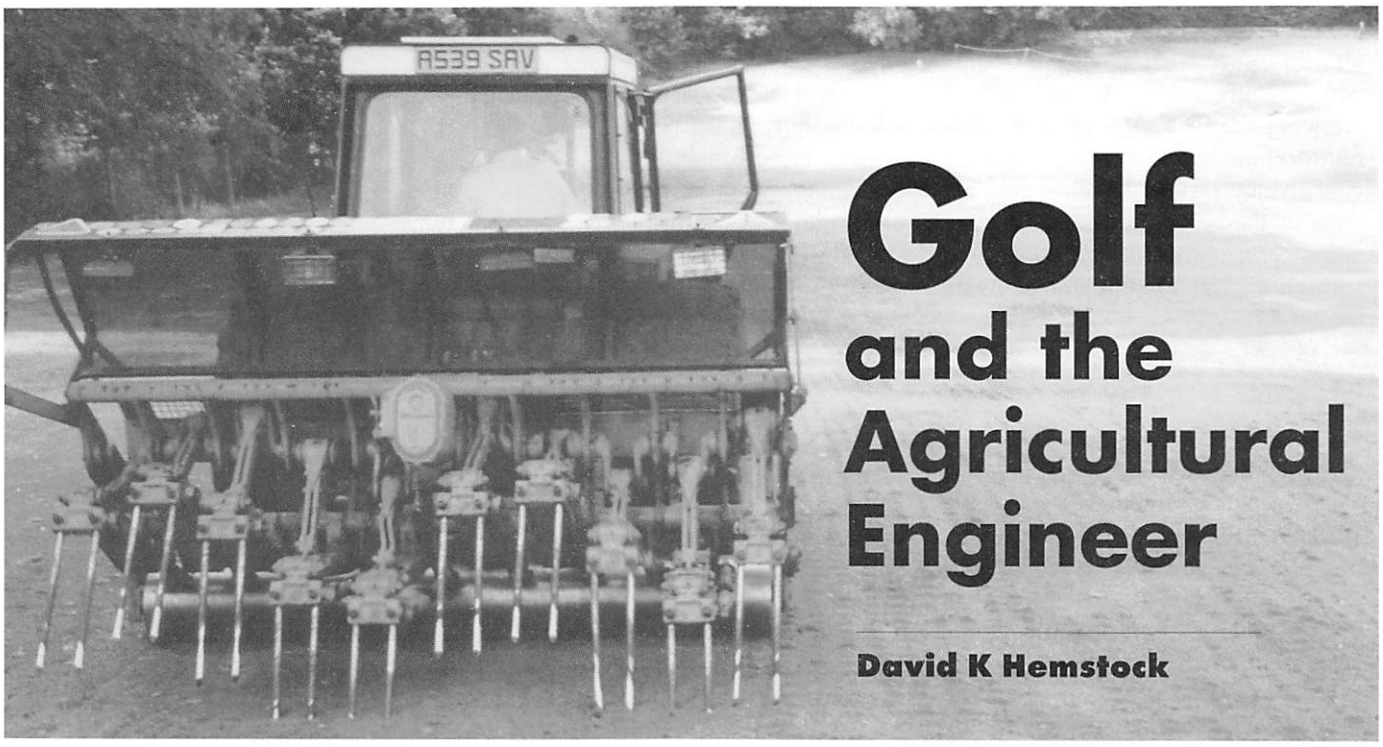
'Off Guard', a film produced by the Health and Safety Executive (HSE), has been awarded first prize at the International Film Festival during the World Congress for Health and Safety held in Madrid during April 1996.

The video looks at the dangers of using an agricultural Power Take - off Shaft (PTO) which rotates at high speed to power agricultural machinery. If a person or their clothing comes into contact with an unguarded PTO they can become trapped within seconds, resulting in serious, often fatal injury.

Greg Bungay, Head of HSE's Agricultural National Interest Group, who received the award said: "Off Guard is an important part of our strategy for training and influencing young people entering the industry; to raise their awareness of the dangers of farm machinery and to encourage safe working practice on farm. Our aim is to reduce the terrible toll of fatal and serious injuries involving machinery and Off Guard is playing its part."

Over 250 films on occupational safety and health were entered for the competition. Forty nine films from 24 countries world-wide were short-listed for entry at the Festival, five of these were produced in the UK, the maximum from any single country. The festival brings together films and videos from all over the world and provides an international forum for issues relating to health and safety at work to be discussed.

Copies of Off Guard are available for hire, priced £11.49 (free loan to colleges of agriculture, higher and further education establishments), or can be bought, priced £38.30 from: **CFL Vision, PO Box 35, Wetherby, West Yorkshire LS23 7EX**




# Golf and the Agricultural Engineer

David K Hemstock

**Soil loosening (decompaction) without turf disruption: the Vertidrain technique.**

The world of golf course design and construction appears to be dominated by the big-name golfers, but closer inspection reveals that it is very much the realm of the engineer, who preferably also has an understanding of the relationships between soil, water and plants.

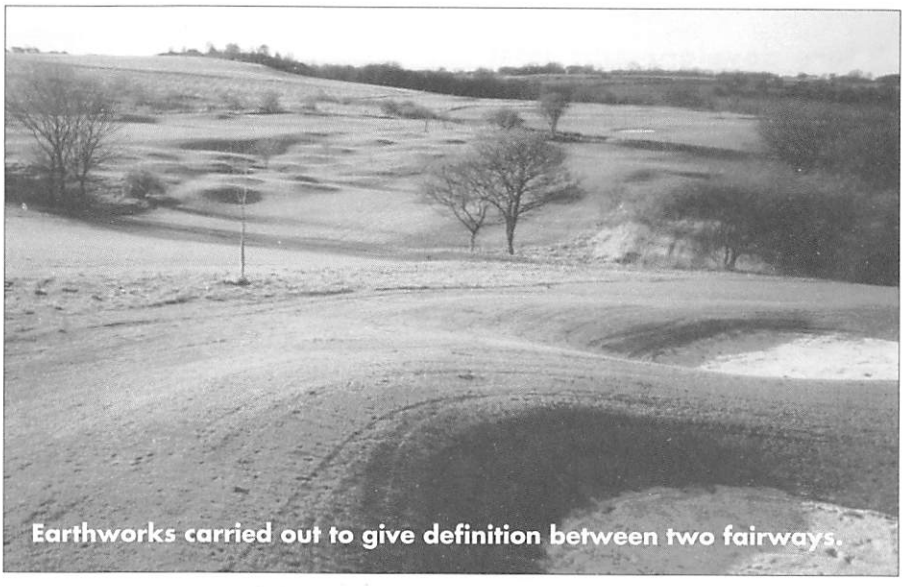
Why the emphasis on plants? The ultimate and primary difference between agricultural grass production and turf management for golf is that turf on the golf course is grown under severely exacting conditions, with the grass living on the edge of terminal stress for large parts of the year. This is the opposite to grass production, where stresses are limited and every effort is taken to give growth full reign. Considerable attention has to be given, from the design to the construction stages, to the ultimate aim of establishing a good turf cover.

These stresses include drought, a minimal fertiliser application programme, and trampling whilst the soil is damp. Golfers are relentless in the pursuit of the game, and demand play right through the year on perfect turf. Comprehensive drainage is important. Watering is essential in keeping the turf growing and resilient, but beyond covering the couple of hectares which constitute tees and greens, is also prohibitively expensive. So the major proportion of a typical course in the UK normally has to manage without watering.

Fertiliser application also has to be strictly monitored, keeping it to the absolute minimum required to maintain the favoured grass species (Bents, Fescues, Smooth-stalked Meadowgrass, etc.). Any excess fertiliser application encourages weed grass invasion, specifically Annual Meadowgrass, which turns an unsightly sickly yellow/green with the onset of Winter.

## Design and construction

A new golf construction project of any size involves earthworks, ponds and water storage, irrigation, drainage, soil

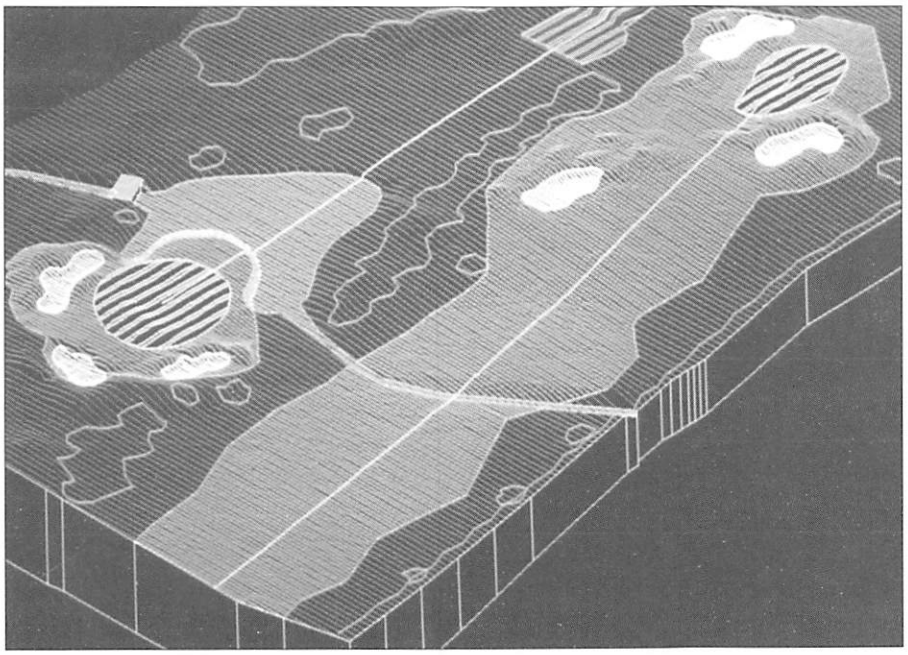


**Earthworks carried out to give definition between two fairways.**

***David Hemstock runs his own consultancy, David Hemstock Associates, which is almost exclusively golf course orientated and which attracts more and more work from overseas, including Mediterranean countries, China and India. He would welcome links with other Members, both in the UK and overseas, who have an interest in the golf world. David Hemstock Associates, Suite 4d, East Mill, Bridgefoot, Belper, Derbyshire DE56 1XU. Tel/Fax: +44 (0)1773 827115.***

management, landscaping and environmental considerations, and of course machinery, all of interest to the Agricultural Engineer.

There is an extra challenge in managing all of these aspects simultaneously, co-ordinating each aspect within what is normally a very short construction period, particularly given the interruptions of the weather. Soil care on stripping and replacement is critical, if future management of the turf is given consideration. As with minerals site restoration, careless handling of topsoil lives on with the manager of the area for many, many years.



**CAD is an invaluable tool in helping visualise the intended design.**

It is impossible to avoid topsoil stripping and the recontouring of the subsoil, because of the nature of golf course design. Each golf hole should look interesting, and have a playing character which is different to other holes on the course. This is achieved by forming mounds, bunkers, hollows, perhaps a pond or re-routed watercourse.

With the brief to be creative and innovative, the design of a golf course does include imagination. The successful promotion of a project often requires something new and different to be included in order to be fully saleable by the promotional experts.

This has led to extreme and possibly over-elaborated design features, a classic example being the 14th hole at the Coeur D'Alene Golf Course in the United States. This features an artificial floating island with a putting green on it, the whole structure being wound out into the lake and back in again depending on the difficulty of the hole required on that day, with the only access via a cable-operated ferry.

Such ideas lead to interesting technical design problems, but are a far cry from the very naturally formed courses from which golf originated hundreds of years ago, on the links-land of Scotland (so the story goes, although playful stone-age man no doubt found a frivolous use for club and rounded pebble).

## Environmental issues

This tendency to over-elaborate does not endear golf courses to the environmentalist, but is only now being brought under control. There is a still thriving demand for newer and better golf courses. Europe, and the UK in particular, have recently been through a period of rapid new course development, brought to an end perhaps temporarily by the recession.

An after effect in the UK has been for the new, well-constructed courses to put pressure on older courses to improve, hence the present active remodelling and upgrading scene, which provides an interesting opportunity to put right the mistakes of the past

The rest of Europe is still slowly developing courses, and one assumes will continue to do so given the inexorable growth of golf over the last few hundred years. Environmental issues are becoming very critical to new course development and also to upgrading to a lesser extent, nowhere more so than in Germany. Here controls, particularly in the south of the country are very tight on new courses, and rightly so.

It is difficult to argue against golf being an urbanisation of the countryside, especially with the tendency to fundamentally change both contouring and landscape impact, not to mention the bric-a-brac of marker posts, flags and the irresistible temptation that golfers seem to have to adorn their course as if it were a household garden.

Planners, when considering an application for a new course, need only look at the local golf course, with its Leylandii screens, Rhododendron, Berberis and Cherry Laurel plantations, and the stark white sand of the bunkers to see something which cannot really be called natural countryside.

Why does golf require such an imposition on the countryside? The answer is that it does not, as exemplified by the numerous courses around the country which actively improve environmental and ecological value. Planning Authorities have not had the power, or have not been able to use it, to make sure that schemes are properly planned, and that checks are made after construction to ensure that landscape design and management plans are being followed.

Although most designers would say that natural is best, there are always pressures, particularly from the developer whose confidence requires there to be elaboration with landscaping, to 'improve' on nature to the detriment of the project and the environment.

## Technical input

In addition to the aesthetics, a golf course properly designed is a highly technical exercise, hence the essential involvement of a team of specialists which would normally include engineers, agronomists, scientists and architects of one kind or another.

The key to a well constructed and successfully managed course is control of the soil/plant/water relationship. Putting greens must have a consistent surface in terms of weather conditions, not affected by rain or drought, in order that the golfer experiences constant run-

of-the-ball in his search for the hole, that distant 4 + inch target.

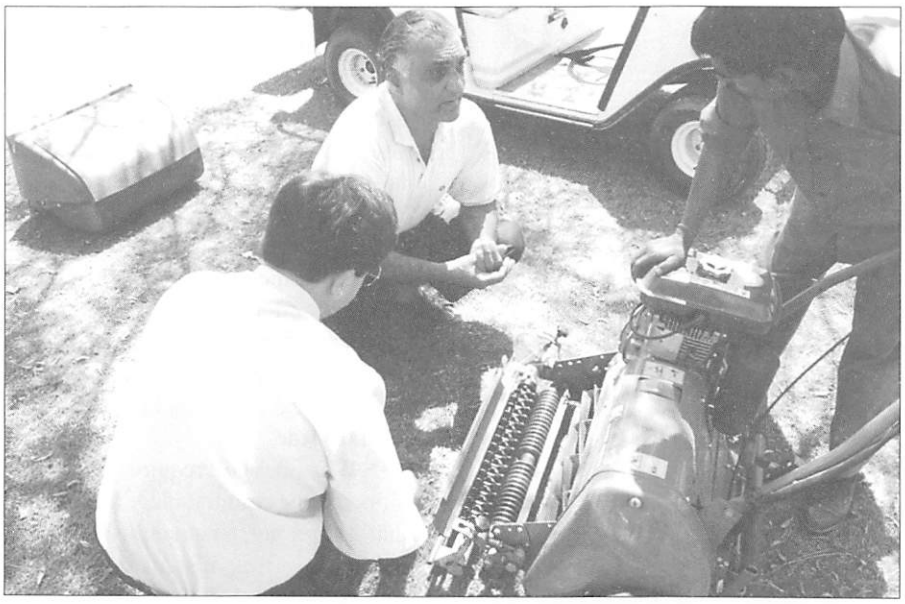
Modern green construction involves forming layers of pipe drainage, gravel, and purpose-mixed free draining rootzone. This ensures perfect drainage, but of course also demands irrigation when conditions dry out.

Since golfers play from early morning to late in the evening, and do not appreciate a dowsing from sprinklers, the irrigation system normally works automatically and at night. The typical set up will have a pump and pressure set to keep the system permanently pressurised, with a ring main design to equalise pressures, and an electronic controller operating solenoid valves out on the course. Sprinkler spacings have to be accurately calculated, since they are fixed in one place, and any shortfall in the coverage and overlap needs expensive hand-watering to correct.

Sprinklers situated around the greens, tees and other areas pop-up automatically in sequence, according to the greenkeepers settings. The water management cycle may be completed by collection and recirculation of drainage water, an increasingly common feature on newer courses. Recirculation serves several purposes, adding to water conservation efficiency, reducing nutrient run-off, and also allowing water to be pumped around the water features on the course for aeration and effect.

A series of ponds might be linked to form a water storage facility, giving sufficient surface area to avoid unsightly draw-down effects. This is usually seen as preferable to constructing a purpose-made reservoir hidden away from the course.

Water quality is important, particularly the pH which should be neutral or below, and freedom from contaminants. Some water sources are treated by acid-dosing, to bring down the pH to a level which favours the Bent/Fescue grasses rather than Annual Meadowgrass.



**Choosing the right maintenance equipment, and setting up correctly for the particular conditions is important.**

## Drainage & Maintenance

Once opened, the greenkeeper has a constant battle countering the effects of wear and soil compaction, brought about by the combined effect of golfers feet and the trafficking of his own machinery. The job is made easier if drainage and irrigation aspects are well catered for.

Golf courses are land-hungry, and for various reasons, which include high land values, are very often put down on land which is not ideal for the purpose. The ideal would be gently undulating land with a sandy topsoil, but in the UK the majority of courses are on heavy soil which is not suited to trafficking throughout the Winter. And the primary factor in choosing a site for a course has to be the proximity of a good population of golfers Hence the trend to use 'disadvantaged' land close to towns and cities for development.

Since once a course is turfed, what is underneath will not be disturbed by ploughing or subsoiling, and land previously affected by quarrying, with little topsoil depth, stoney or poor subsoil, which would be very unproductive agriculturally, can be put to good use.

Drainage has to be good, and the typical system on a heavy soil site would consist of 80 mm pipes laid at between 5 and 15 metres spacing, with permeable fill up to 150 mm. Connecting with these would be a shallower, surface drainage system, of sand-slits or grooves, which are intended to remove water quickly off of the surface before too much damage by traffic causes puddling. Normally the

**Sand slitting equipment for drainage into existing turf.**

flatter, lower areas are treated this way, with what is intended to be a long-life system..

On highly shaped areas, advantage can be taken of the drainage effect of slopes using a swale-system of surface water collection, where water is allowed to run into hollows with strategically placed inlets into the pipe system underneath. This is often referred to as an American system, because it is more suited to intensive rather than steady-state rainfall conditions.

## Maintenance

Any vigorous subsoil loosening would disrupt the turf too much, and so techniques such as mechanical forking, or 'Vertidraining' have been developed. The battle against compaction is one of the more serious that the greenkeeper faces, made more difficult by additional problems such as high stone content of some soils.

It is an area where there are many manufactured machines on the market, but there is little definitive research work on which works best in what conditions.

The nature of golf courses, with their infinite variety, does cause problems with maintenance. A machine built for standard conditions will not be capable of tackling certain circumstances, and if the conditions are such that no machine is made to cope with them, the course managers have a predicament. For anyone regularly visiting golf clubs with problems, the circumstances can arise where the machine to do a particular job does not yet exist.

Maintenance implications have to be considered, therefore, right from the design stages, so that the 'Catch-22' situation does not occur.

Around the world, golf course development is forging ahead, particularly as countries embark on programmes to provide travelling businessmen and golf tourism with better facilities on which to play. The Pacific Rim countries are the leaders in this type of development at present, but are coming under more environmental control, and are starting to reach an equilibrium with supply and demand. However, the situation does not remain fixed or static whatever the country and present circumstances, leading to a permanent state of flux, and considerable work for the consultancy fraternity.

# Book reviews

## Farm Building Cost Guide 1996

*Editor: Tony Petchey*
Publisher: SAC
Price: £18.70 (plus £1.40 postage)

Farm building costs have shown only a small increase over the previous year, according to the latest edition of the annual ***Farm Building Cost Guide*** published by the SAC Centre for Rural Building, Aberdeen. Generally, material costs showed a modest increase. Exceptions were the costs of some concrete materials which increased by up to 15%; conversely, paint prices were nearly 13% lower. However, when labour costs are included, overall building costs appear only slightly higher than last year. Grants for building work are now more restricted than formerly.

Now in its twenty-second edition, the ***Farm Building Cost Guide*** is the only published comprehensive guide to farm building costs in the UK. Updated annually, it lists costs of all materials and equipment commonly used in farm buildings and gives full cost analyses of a range of typical modern buildings. It also includes a quick reference section giving information on costs of the main types of agricultural buildings. Cost index figures are given which enable rapid updating of building costs for purposes such as insurance valuation. There are features on appraising building investment, grants and incentives available for building and related work on farms, and on standard costs for grant-aided work.

## On-farm Drying and Storage Systems

*by Otto J Loewer, Thomas C Bridges, Ray A Bucklin*
Publisher: ASAE, St. Joseph, Michigan, 1994.

This is an unusual textbook. Its 560 pages, written for a wide audience embracing farmers, contractors, engineers and students of such topics as Agricultural Operations Management, are supplemented by computer software, allegedly available on World Wide Web, or by contacting the senior author. A range of programmes covering the mathematical simulation of various drying processes, equipment design, layout and system evaluation including economics, are promised for the use of the reader. More of this anon.

In the Preface, the senior author refers to the work as a reference book. Certainly this is an accurate description: technical terms are defined, units of measurement explained and procedures (such as calculation of shrinkage) discussed, often with numerical examples. This approach will be welcomed by many European readers who will be helped to understand the use of bushels, weight bushels, dry matter bushels and volume bushels. Perhaps, however, the rigid adherence to the USA version of Imperial Units throughout the book will reduce its attractiveness to European readers who, by now, must surely be more accustomed to SI (or "metricated") units.

The use of "horsepower" "Btu" and "inches of water" have become outdated in most grain dealings on this side of the Atlantic, and "cfm per bushel" has always seemed an archaic unit, even to this reviewer.

From the title of the book one might expect reference to a wide range of farm produced crops, but the authors confine their attentions strictly to grain (mainly "corn") and beans. No mention is found of the small seeds (grasses, linseed, etc.), or of fibre or forage crops.

In spite of these observations, however, the book is a useful addition to the library shelves. The authors have made special efforts to explain a range of potential problems, which may be encountered on the farm, from possible non-uniformity of airflow in ventilated bins and the development of microbial infestation and infection, to the more obvious hazards to operators arising from careless unloading of sites and storage bins.

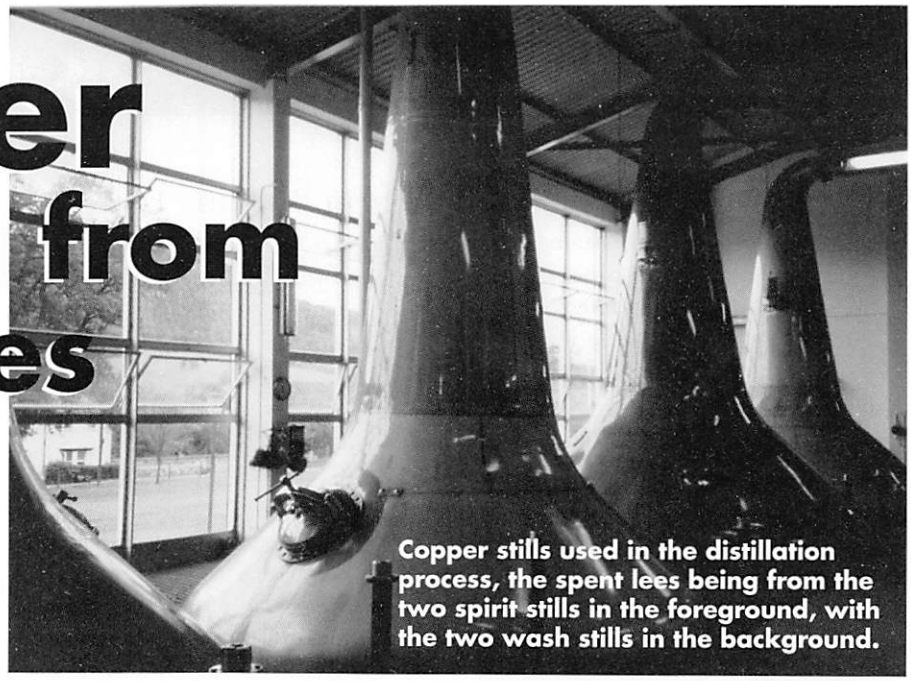
Materials handling receives special attention, and the selection and layout of complete grain systems are treated at length. An extensive final chapter on economics and marketing ensures that the reader is kept well in touch with reality.

The major disappointment of the book was its promise of availability of computer programmes on the World Wide Web. Repeated attempts failed to call up more than the introductory promise of these programmes, at least in Bedfordshire, England!

*BCS*

# Copper removal from spent lees

**Steven Hunter**



**Copper stills used in the distillation process, the spent lees being from the two spirit stills in the foreground, with the two wash stills in the background.**

The presence of copper in distillery effluent, notably spent lees which is the liquid residue of the second distillation and has typical copper concentrations of around 25 mg/l, gives rise to concern on environmental grounds.

Copper is a toxic element and is regulated by several pieces of legislation, both UK and EU. A Code of Practice also exists which seeks to control its accumulation in soil when copper containing wastes are disposed of to land.

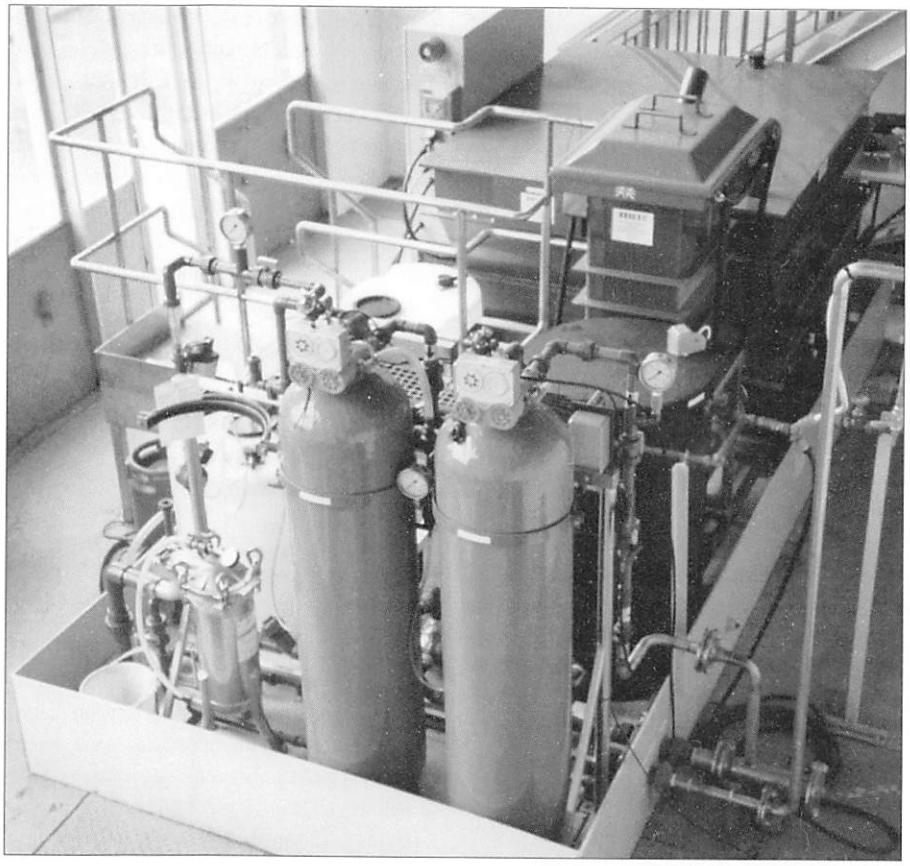
Treatment of the weaker distillery effluents, such as spent lees, caustic wash waters and evaporator condensate, by biological filtration, serves to concentrate the copper by adsorption and precipitation. Consequently, the final effluent discharged to a watercourse does not contain significant levels of copper (< 1 mg/l) but, instead, the copper is concentrated in the bioplant sludge which can contain in excess of 1% on a dry matter basis. Subsequent disposal of this sludge on to farmland leads to the build up of high concentrations of copper in the soil over time, unless properly managed.

Many regulatory authorities are beginning to impose restrictions on the amounts of copper discharged to inland freshwaters, estuaries and coastal waters, and at present, many distilleries discharge untreated effluent into coastal waters.

Work undertaken by United Distillers on behalf of the Malt Distillers Association of Scotland identified ion exchange and electro-deposition as the best means of removing copper from the spent lees.

A full scale pilot plant, supplied by BEWT (Water Engineers) Ltd. of Alcester, was installed at Aberfeldy Distillery in September of 1994 and has been operating consistently since then, treating all of the spent lees from the distillery, some 133 $m^3$/week.

Although initial results were



**The copper removal plant with the two ion exchange columns (foreground), and the electro-chemical cell and tank in the background**

***Steven Hunter is Environmental Compliance Manager, United Distillers, 1 Trinity Rd, Elgin, Moray IV30 1UF.***

promising, with > 99% of the copper being removed, it was realised that some fine tuning was necessary to take the project to the final stage. To this end a specialist company dealing with ion exchange, Memcor Ltd of Derby, was called in to develop a working system which would be appropriate for installation at any malt distillery.

The following is a brief description of the process. Spent lees is passed through two cationic ion exchange columns, operated in a lead-lag fashion, to remove the copper. The decoppered spent lees is then passed forward for further treatment, the method of which depends on the geographical location of the distillery.

The system operates in this manner until the lead column becomes saturated with copper, at which time the column will be backwashed with water and regenerated with sulphuric acid. The resulting copper sulphate solution, which has a copper concentration upwards of 20 000 mg/l, is directed to a holding tank for subsequent electro-winning. The electro-chemical cell is run for approximately 8 hours during which time the copper is plated out onto stainless steel cathodes. After a period of time this copper can be peeled from the cathodes and recycled. An average sized distillery processing 100 tonnes of malt per week will lose approximately 4 kg of copper from the stills and condensers.

At the end of each electro-chemical operation, a sulphuric acid solution of approximately 5% is produced. After the addition of new sulphuric acid to increase the strength, this can be reused for the next regeneration.

It is intended that all participating distilleries will have an on-site ion exchange manifold system to remove the copper from the spent lees. Upon saturation, the columns will be removed and transported to a central regeneration and electro-chemical plant.

By using a combination of ion exchange and electrolysis, > 99% of the copper can be removed from the spent lees , with the result that distilleries will be able to discharge to controlled waters without being restrained by copper concentrations. These techniques will also allow those distilleries with effluent treatment plants on site to continue to dispose of bioplant sludge to farmland with the knowledge that they are not restrained by the concentration of copper.

# Impact of the Central Railway

The Oxford office of **Carter Jonas** - the national firm of Chartered Surveyors - has provided over 20 Buckinghamshire and Northamptonshire landowners with advice on lodging objections on The **Central Railway Order** (CRO), **1996** to the Secretary of State for the Department of Transport. The CRO outlines proposals for the £1.5 billion construction of a 288 km freight link between Leicester and the Channel Tunnel by **Central Railway plc** (CR) which is thought to comprise, among others, French and Canadian railway companies. The link would necessitate the improvement or reinstatement of existing railways and the creation of several new stations and motorail terminals.

The National Farmers Union - although in agreement that freight should, where appropriate, be transferred from road to rail - is concerned that its landowning members interests have not been fully considered by CR. For example, only $^3/_4$ page in CR's Environmental Impact Assessment was devoted to the likely effect of the link's construction and operation on the agricultural industry. This compares to the Channel Tunnel Rail Link's 184 pages on the same subject.

Carter Jonas' assessment for landowners of the CRO and its implementation has included investigations of:

- the blight that may be caused in land values by a potential three year wait until an Inquiry's decision and the long-term blight effect if the link is built;
- CR's potential powers of compulsory purchase;
- the consequences of the CRO's repeal of some significant sections of Section 68 of the Railway Clauses Consolidation Act (1845) - by which CR would be able to deny farmers the right of way over railway lines to severed land;
- the visual effect of the 7 metre - 8 metre high electrical masts spaced at regular 50 metre - 60 metre intervals; the noise pollution caused by 750 metre trains; the omission of any mention of landowners rights (due to twenty years of occupation) to disused railway land or planning permission that may have been obtained for it.

For further information, please contact:
**Mark Charter, Carter Jonas, Oxford.**
**Tel: 01865 511444**

# ROPS for ATVs

A prototype roll-over protective structure (ROPS) designed by the Health and Safety Executive (HSE) and fitted to an all-terrain vehicle (ATV), was shown to the public for the first time at the Royal Highland Show. The prototype structure was produced by HSE's Health and Safety Laboratory (HSL) as part of a research project to establish how ATV riders can be protected in the event of a sideways overturn.

Denis Welstead, who heads the National Interest Group with responsibility for ATVs, said: "HSE has investigated 100 ATV accidents, including seven deaths since 1986, with 'quadbike' type machines. Most of the overturning accidents were to the side involving trapping under the vehicle and crushing injuries."

He added: "HSE has therefore decided to produce a prototype ROPS designed to reduce injuries from lateral overturn. Fitting of a cab or four post frame to protect riders in a forward or rearwards overturn was likely to present practical difficulties both in its fixing and its use."

Mr Welstead said he believed that if ATVs are prevented from overturning further than on to their sides then most of the fatal and serious accidents will be avoided. When the research project is completed the results will be published so that they can be used by ROPS manufacturers and standards makers.

# Improving the sustainability of rural water supplies in NE Uganda

**William J Bradfield**

The Karamoja region of NE Uganda is predominantly semi arid, with the traditional sources of water being mostly shallow wells dug in the seasonal rivers. The inhabitants are mainly semi nomadic pastoralists. The base settlements are more or less permanent, with the men moving away with the herds in the dry season to find pasture.

Borehole drilling, together with tank and dam construction, began in the 1930's and since then approximately 600 boreholes have been drilled in Moroto district alone. During the last 15 years, an International organisation, the Geneva based Lutheran World Federation (LWF) has been involved, among other activities, with water development in Karamoja, originally covering the whole region and, since 1988, Moroto district alone. The activities have been the drilling of new boreholes, recovery of old ones, handpump replacement as well as repair. These have been carried out on behalf of the Directorate of Water Development (DWD), using predominantly DWD seconded staff and equipment.

## Borehole recovery programme

Fuelled by the unstable political situation in the country, Karamoja has suffered for many years from widespread lawlessness due to cattle raiding and banditry. This insecurity has left vast areas abandoned, with the population concentrating in safer areas. With the recent improvement in security, people have been moving back to these areas as well as to new ones. The pressure for water has been intense and, with the drilling programme in operation, the drilling of new boreholes has been the easiest though most expensive option. Only when the most recent drilling programme ceased at the end of 1994 was the borehole recovery programme able to receive the attention it deserved and, with so many abandoned and unused boreholes, it was the more appropriate option.

The tasks which needed to be carried out were: recovery of old boreholes; recovery of normally used boreholes, that is clean-outs and fishing out of dropped pipes; replacement of hand pumps and hand pump repair. Apart from some recoveries using a compressor, the machine that was used to carry out these tasks was a truck-mounted Dando 200 cable tool rig *(Figure 1)*. At the same time, community based pump mechanics were being trained and equipped to repair handpumps (India MKII) with rising mains no deeper than 42 metres, the maximum depth it was envisaged they could lift by hand. India MKIII pumps were being installed at depths deeper than 42 metres on the principle that, with no need to lift the rising main, the pump mechanics could repair these also. Problems were being encountered, however, and these resulted in frequent demands for heavy lifting equipment.

**Fig. 1 Truck-mounted Dando 200 cable tool rig cleaning a borehole.**

***William J Bradfield has recently completed a two year tour of duty as Field Co-ordinator/Water Engineer of the Karamoja Rural Development Programme in NE Uganda, a programme concentrating on agriculture, rural water supplies and rural technology.***

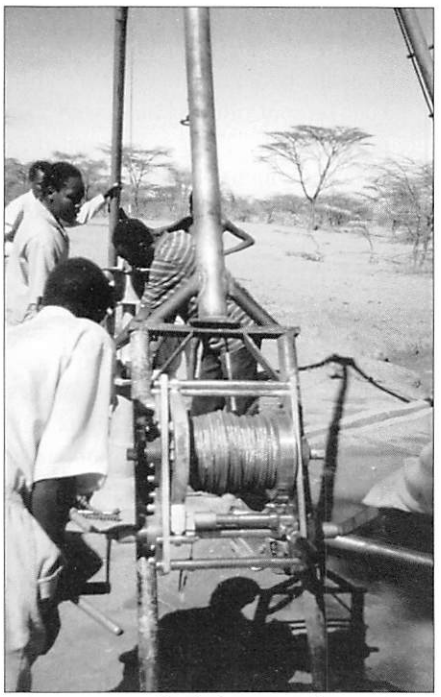


**Fig. 2 Detail of the quadrapod winch.**

Although the Dando 200 was by the standard of many machines an easy tool to maintain and its comparative work rate very fast, the whole unit including the truck was becoming increasingly expensive to maintain and its long term sustainability was questionable. This was especially in view of the move to ensure greater overall sustainability, notably the district administration taking over more responsibility for the service and equipment and the communities contributing more to the cost of this service.

## Better maintenance capability

The need was to improve sustainability, firstly by simplifying the borehole and hand pump maintenance technology, and secondly by increasing the capability of the community based pump mechanics to take on more of the tasks themselves. It was decided, therefore, to introduce and develop the technology based around the tripod.

Firstly, a rather heavy and cumbersome quadrapod of 2 $^{1}/_{2}$ inch (64 mm) G.I. pipe was constructed in the LWF workshop which was equipped with a good and specialised - although expensive - winch imported from the Netherlands *(Figure 2)*. With this equipment, a rising main was lifted, while dropped pipes, both $1^{1}/_{4}$ and $2^{1}/_{2}$ inch (32 and 64 mm), were successfully fished out using special tools made in the workshop *(Figure 3a)*. By a system of clamping, it was also possible to lift and lower 6 metre lengths of pipe. The next step was to carry out light recoveries using various tools, prototypes of which having already been made, tried, and improved through experience *(Figure 3b)*. This was slow and tedious compared to the Dando but from the author's own experience in another country it was a practical way forward. The fact that the Dando was still available and doing this work was the main brake on the rate of progress in this field.

The equipment, together with a full load of up twenty $2^{1}/_{2}$ inch (64 mm) pipes was carried on a Land Rover pickup

**Fig. 4 Block and tackle system for lifting up $2^{1}/_{2}$ inch (64 mm) G.I. pipes.**

**Fig. 3 Some specially made tools: (a) lifter for dropped pipes, both $1^{1}/_{4}$ and $2^{1}/_{2}$ inch (32 and 64 mm); and (b) from L to R, bailer, simple fishing tool, and hammer/prodder.**

which was cheaper to run and more suitable for reaching the often poorly accessible sites than a heavy 2WD truck.

The second component of the task was to further empower the pump mechanics. A lighter and cheaper tripod of 2 inch (51 mm) G.I. pipe was built. Construction was simplified by flattening the end of each leg, cutting a hole, and then using a strong bolt to join the legs and incorporate a shackle to hang the lifting tackle. Together with a block and tackle system, it was capable of lifting and lowering rising main *(Figure 4)*. Initially, two double sheave pulley blocks with 18 mm nylon rope were used, with the top block being later changed to 3 sheave. This increased the lifting capacity further, making it possible for men to lift twenty $2^1/_2$inch (64 mm) G.I. pipes full of water *(Figure 5)*.

At the present time, the block and tackle system has been field tested by the LWF crews who have found it quicker and easier for lifting a rising main than the winch, as well as successfully demonstrated in a special course for the pump mechanics. The process has begun of distributing a tripod together with blocks and tackle to each subcounty, initially to those where boreholes are concentrated closer together. There, the pump mechanics will have easy access to them. The tripod legs break down into 3 m lengths so there is no component restricted by weight and it remains to be monitored how the pump mechanics organise the removal of the tripods to the sites.

This all means that technically the pump mechanics are now capable of carrying out all hand pump repairs, leaving the centrally based (LWF)/DWD) crews to concentrate on recovery, which as we have seen is also being made simpler. There is no reason why further work cannot be done to enable some light recovery by the pump mechanics. A small hammer and bailer on a reasonably strong rope can be controlled by hand with a single pulley block. The greatest constraint to the development of these initiatives is the availability of the alternatives, albeit less sustainable - in these cases, the Dando and the LWF crews.

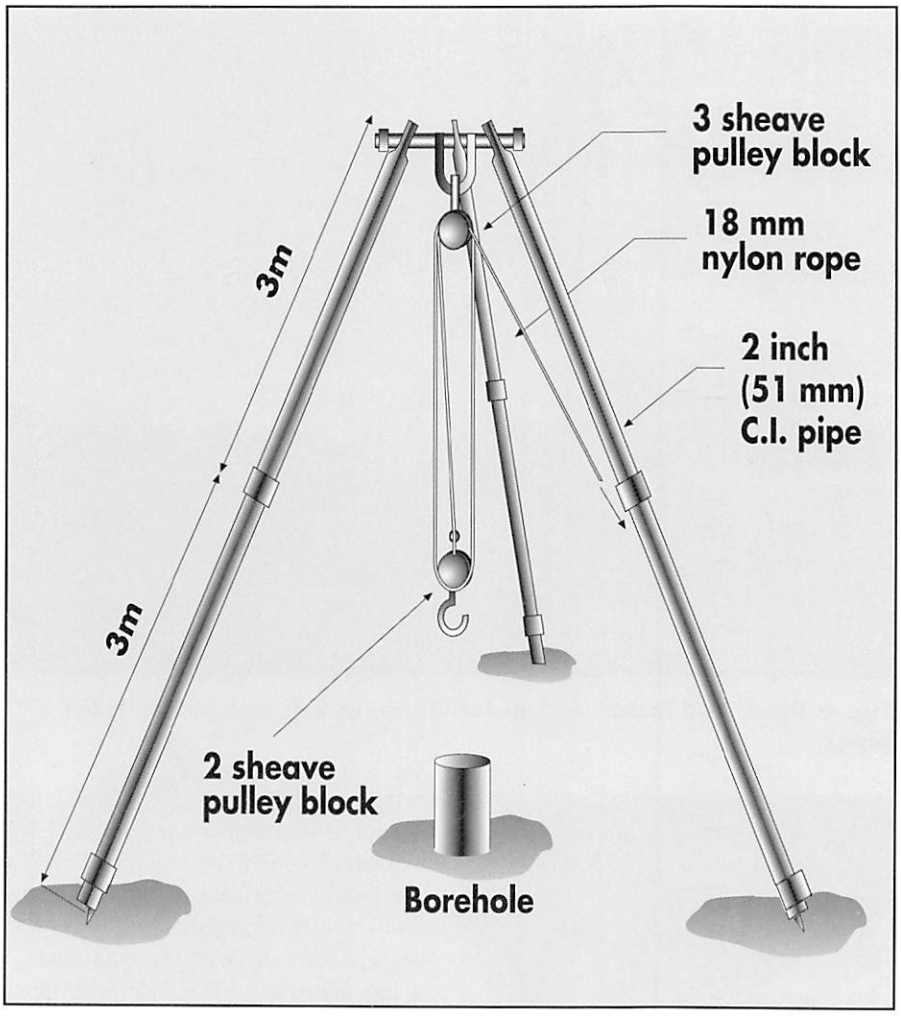



**Fig. 5 Construction details of simple tripod and pulley block system.**

## Servicing sustainability

Of course, costs and the meeting of these costs always come into the sustainability equation. The communities remunerate the pump mechanics for their services and this is working well. At the moment, they do not pay for work carried out by the LWF/DWD crews. Charges are being introduced but the long term financial viability of this is bound to be difficult to guarantee. The more that can be carried out by the pump mechanics, the simpler it will be.

The full cost of construction of a tripod with block and tackle and 25 metres of 18 mm nylon rope is approximately 450,000 Uganda Shillings (US$ 450), the most likely part needing replacement being the rope. Otherwise, there are no complicated and expensive parts and the later tripod has been designed so that most of it can be made and repaired by blacksmiths.

Taking the wider view, there are of course other aspects of ensuring overall sustainability, notably the availability and cost of hand pump spares and replacement of tools for the pump mechanics. Currently, prices of spares are being raised closer to the real cost but the components are still supplied by LWF and DWD. Work still has to be done to get them accepted at full cost and supplied by the private sector. The situation is similar for handtools.

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Autumn 1996

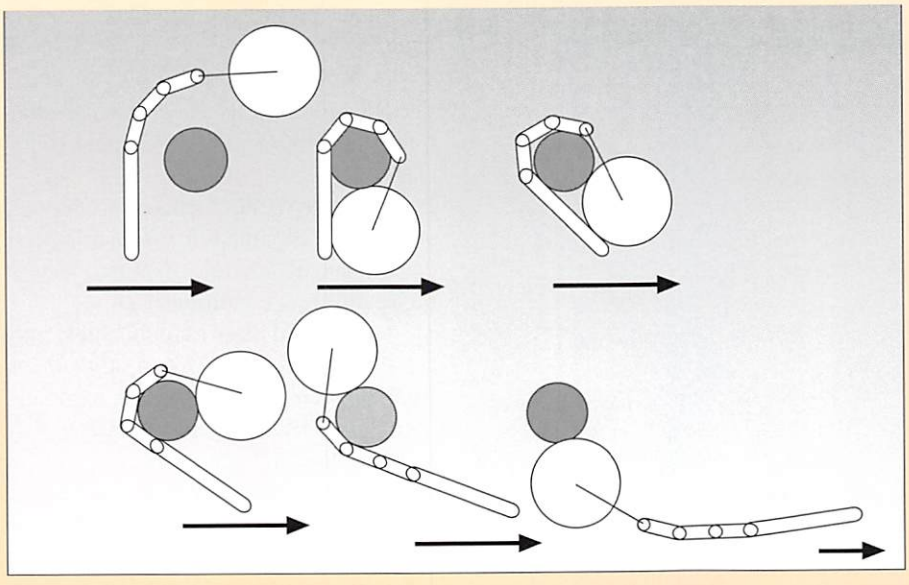
# Faster verge cutting around posts

Stephen Williams BEng AIAgrE, was awarded the Johnson New Holland Trophy Award 1995 Second Prize for his project, 'Verge mowing around posts'. The presentation took place at the IAgrE Annual Convention at Writtle College on 2 April.

The purpose of the project was to modify a flail mower used for roadside verges to cut grass around posts as well, thereby eliminating the need for any follow-up with a hand held strimmer. The novel mechanism was fixed to the cutting head of the verge mower and consists of a series of links with a rotary cutter on the final link. Posts encountered by the linkage arm automatically trigger a reaction which causes the links to wrap forwards around the post. As the forward movement of the mower continues, the rotary cutter gets dragged backwards around the post, cutting the surrounding vegetation in the process. Tests on a full scale model satisfactorily demonstrated the potential of the concept. Slight modifications, introduced during the test programme, extended the sizes of posts covered to a range of 50 - 300 mm nominal diameter.

Stephen grew up on the family hill farm near Llandrindod Wells in Mid-Wales. The two main farming enterprises are sheep and beef. In 1991, after A-levels, he started a course in Agricultural Engineering at Silsoe College. After completion of the second year, he opted to take a supervised work experience year at McConnel Ltd in Ludlow. Experience there included CAD, prototype manufacture, developing test procedures and compiling reports. This work also increased understanding in other areas such as sales, marketing and production systems. Another enjoyable year at Silsoe concluded the degree for which he received the grade of 2(i), together with an IMechE prize for the aforementioned project.

Stephen is presently at Evanweld Ltd, Kidderminster and employed through a Teaching Company Scheme.



Cutting cycle of the wrap around trimmer.

## CPD

Many members will already be undertaking Continuing professional Development (CPD) as part of their normal working life, and the Institution has produced a record book, disc and guidance notes for those who wish to keep a record of their CPD activities. It is becoming increasingly important to keep such a record as members (rather than employers) take responsibility for their continuing employability. In addition, evidence of CPD will soon be expected from any members applying for an upgrade in membership or for registration with the Engineering Council.

The record book, disc and guidance notes are available free of charge to members. Simply ring or write to the Secretariat and ask for a set. Members are invited to send in their record books to the Secretariat once a year (either by 1 May or 1 November) for the Education and Training Committee to inspect and offer advice.

It could be very useful to your career.

**Michael Hurst**
**Secretary**

# Graduate survey

At a recent brain storming session at the IAgrE, the very purpose and future of the organisation was questioned. To keep the Institution alive needs money, and most of this money is provided by members. The question is: How does one provide the value of the subscription and so attract new membership?

In order to help the Executive develop the IAgrE into a more desirable organisation, it was agreed that getting the views of young members (and potential members) would be helpful. To this end, a questionnaire was sent to 100 Harper Adams Engineering Graduates and Diplomates who had left college within the past three years. This was fairly open-ended, questioning their interest and involvement in the Institution and then looking for what they saw as the major value of membership. Additional services that the Institution might provide to encourage non-members to join were also requested. The major findings of this survey were that only 28 students were interested enough in the Institution to respond. Eleven of these were paid up members of the Institution and five attended meetings. Only thirteen were employed in agricultural engineering.

At first glance, the responses to the questions regarding desirable services provided a plethora of unrelated suggestions and requirements. On further analysis, however, some patterns do emerge. These are summarised below as the major areas of importance.

•Status (Chartered Status, Career Development, the name of the Institution)
**18** references.
•Information (Developments of new machinery (10 references) and technologies. Research and development findings).
**12** references.
•Networking (Visits and meetings, contacts within the industry).
**9** references.
•Publications (The Journal and Year Book)
**8** references.
•Employment News
**4** references.
•Green Issues
**3** references.

So what does all this tell us? 80+% of graduates are not interested in the Institution? The Institution largely satisfies the requirements of the 20% who are interested? If that is all, it is of little real value.

To replace members reaching retirement alone, we need to find 40 new recruits a year. Other losses mean that a total of 150 new members are required each year to maintain the status quo. At the present rate of decline, the total membership will be below 1400 in ten year's time. Recruitment from graduating students is not likely to make up for the natural wastage due to the passage of time, let alone total annual loss of numbers.

To attract new members radical action is required. Minor improvements in efficiency or image will not attract new members. Some suggestions from the survey only raised once may be as important as the request for more product and employment information as they show more original thinking. Three suggestions are worth looking at more closely.

1. Provide discount packages to attend shows.
2. Act as a marriage broker between buyer and supplier (should this be through the AEA?).
3. Encourage more networking between members to provide advice and information. This might include a register of individuals and organisations willing to participate in benchmarking exercises or provide technical assistance.

As the financial constraints on academic establishments increase and approach those present in industry, it will no longer be possible for their staff to support the institution free of charge. The provision of limited status and cosy social get-togethers will not be enough to attract the necessary members to finance continuing existence. Real services of value to the whole industry must be found or the Institution will slowly wither away. Can members add to the rather limited list provided above or will a similar survey being carried out through ex-Writtle students provide a more valuable insight into what young engineers are looking for?

*GFDW*

## *Herts and Essex Branch*

# Young Engineers competition

Wednesday 12 June 1996 was the date for this year's "Young Engineer" project competition, held at Writtle College. The branch managed to secure the services of around 15 judges, some committee members and a few invited guests. We were fortunate in that Mike Dwyer (current President) agreed to come along to act as one of the judges. A Bulgarian university lecturer who was visiting Writtle also joined in with the other judges (and appeared to enjoy the occasion).

The projects on display, from around 18 HND/BSc Agricultural Engineering students, were as usual wide ranging in their scope. There were projects on research into flash floods resulting from the enlargement of field size, investigations into trickle irrigation porous pipes, and evaluations of livestock transport and turkey housing conditions.

After around 2 hours of intense questioning by the teams of judges, it was decision time. In the HND bracket, the first prize was awarded to **David Gregory** for his study into the design of a hand cranked peanut butter mill. He took a traditional meat mincer and carried out some experimental work on this.

Three further HND projects were awarded 'highly commanded' certificates:

1. **Robert Causer** for his study into the selection of a flywheel for manually powered equipment in developing countries;
2. **Colm Heslin** for his project evaluation of an apparatus for measuring the coefficient of friction of potato tubers under different conditions;
3. **Edward Skewes** for his study into a remote digger suspension adjustment for a Standen potato harvester, work initiated during Edward's sandwich placement at Standen Engineering.

In the BSc category, the judges awarded overall winner to **Duncan Smith** for his study of the relationships between blade angle, speed and air flow

patterns in cylinder mower cutting units. The judges were particularly pleased to see the hard work Duncan had obviously put in, and also the enthusiasm of Duncan's presentation.

A 'highly commended' certificate was awarded to **Simon Tinkler** for his study and design of a mechanism for emptying latrines in refugee camps. He had successfully built a hydraulically driven 'pump' and tested it using pig manure as a waste product.

Mike Dwyer made the presentations and at the same time offered some friendly advice to the students on how to improve their presentations in the future. Notwithstanding this, he remarked on the high standards of projects on display and said he had thoroughly enjoyed the evening. Mike also took the opportunity, quite rightly, to extol the virtues of joining the Institution for the benefit of those students not already members.

The evening was closed with the BEng students showing off their model tractors recently entered into the IAgrE tractor pulling contest.

*RWL*

# Initiative on transport 2020

**The Engineering Council has proposed a major initiative to develop, over the next 18 months, a vision of what transport system the nation could have for the future, with a time horizon of 2020. The initial thoughts are to hold a series of seminars in which all organisations within the Engineering Council will be invited to actively participate; and to conclude the seminars with a final report.**

**The first seminar would aim to establish the likely influences on the demand for transport in 2020. Subsequent seminars would follow, taking each mode of transport in turn to identify options for meeting the demand, identifying technological and investment opportunities and how environmental challenges are to be encountered. Although individual institutions will take a lead in various areas, it will be important to present in the final report a vision for transport in which there is integration between the different modes. This initiative is also an important opportunity to involve younger members.**

**Representatives from a small number of Institutions whose prime interest is in transport have held a preliminary meeting to provide a framework for the seminars and information to date is available from:** Robert Huxford, ICE. Tel: 0171-222 7722.

# Unification comes to the regions

Proposals to set up a new regional structure for the engineering profession have been submitted to the Engineering Council's new Board for the Engineering Profession (BEP). They call for ten English regions, plus Scotland, Wales and Northern Ireland, to match the areas served by the regional Government offices. The 13 new organisations would be based on the principle of joint activity between the engineering Institutions.

Each organisation would be responsible for:

- facilitating co-operation, participation and co-ordination of activities between Institutions in its area;
- providing a base for engineering Institutions to work even closer together;
- managing agreed joint venture projects, which would include schools liaison, support for the Year of Engineering Success, in 1997, and promoting the profession locally.

These important proposals have been put to the Institutions and the present Engineering Council Regional Organisations for comment, prior to consideration by the Senate of the Council at a special meeting in late August. Brian Kent, Chairman of the BEP, said: "This interim report represents an important milestone in our drive to optimise regional resources in the national interest and to the lasting benefit of the profession as a whole."

# Long service certificates

## 50 years

| *Name* | *Grade* | *Date of Anniversary* |
|---|---|---|
| John Priestley **Inglis** | MIAgrE | 1 June 1996 |
| Robert Henry **Marsden** | IEng MIAgrE | 12 Aug 1996 |

## 35 years

| *Name* | *Grade* | *Date of Anniversary* |
|---|---|---|
| George Shepstone **Bartlett** | IEng MIAgrE | 26 Sep 1996 |
| Trevor George **Coss** | CEng MIAgrE | 26 Sep 1996 |
| Henning Frederick **Von Kaufman** | IEng MIAgrE | 26 Sep 1996 |
| Alan **Lavers** | MIAgrE | 26 Sep 1996 |
| Frederick William **Sherrell** | CEng MIAgrE | 26 Sep 1996 |
| Gordon **Spoor** | CEng MIAgrE | 26 Sep 1996 |

## 25 years

| *Name* | *Grade* | *Date of Anniversary* |
|---|---|---|
| Peter Worland **Woodliffe** | IEng MIAgrE | 22 Jul 1996 |
| Jeffrey George **Beck** | CIAgrE | 22 Jul 1996 |
| Richard David John **Lacey** | CEng FIAgrE | 22 Jul 1996 |
| William Thomas Roadnight **Lock** | IEng MIAgrE | 22 Jul 1996 |
| Christopher Barry **Stansfield** | IEng MIAgrE | 22 Jul 1996 |
| Michael Douglas Parry **Matthews** | IEng MIAgrE | 22 Jul 1996 |
| Leonard Bryan **Ollier** | MIAgrE | 22 Jul 1996 |
| Francis Raymond **Frampton** | MIAgrE | 22 Jul 1996 |
| Michael Lawrence **Swallow** | IEng MIAgrE | 23 Sep 1996 |

# Mathematical modelling of drying and storage

This was the topic of a joint meeting between the Solids Drying Group of the Institution of Chemical Engineers and the Drying, Storage and Processing Group of the Institution of Agricultural Engineers which was held at Silsoe Research Institute (SRI) on Thursday, 13 June. Thirty-four agricultural and chemical engineers were welcomed to the Institute by Brian Stenning, Chairman of the Drying, Storage and Processing Group and chairman for the morning session.

Dr Dean Burfoot, Head of the Heat and Mass Flow Group at SRI began the proceedings with a short overview of current work on storage and drying at SRI. Dr Ian Bibby, a member of Dean's Group then talked about the application of computational fluid dynamics (CFD) to the **Modified atmosphere storage of grain.** The work is a joint project with Central Science Laboratory, Slough and ADAS in which data on the injection and decay of carbon dioxide in large commercial silos is being used to assess insect mortality and to develop and verify a three dimensional model of the movement of the heat and gas concentrations. The model will be used to develop dosing schedules for the treatment of commercial stores. Ian showed how the model was predicting changes in a sealed silo and in one with a leaky head space and cyclic temperature fluctuation on the walls. Ian's presentation concluded with a fascinating video animation of the predicted changes.

Dr Ian Kemp of SPS at Harwell then presented an overview of current approaches in chemical engineering to the **Modelling and design of convective dryers.** He divided the solutions into product model and plant model. The relative importance of each of these parts of the solution was identified. The difficulties of predictive modelling of product drying characteristics was described and it was observed that practical experiment is necessary to characterise these parameters. The use of scaling techniques was described to adapt pilot scale trials to full scale plant operations. The approaches discussed were entirely in accord with those taken by agricultural engineers.

**Heat and moisture transfer in potato storage** was discussed by Dr Yongfu Xu, another member of the Heat and Mass Flow Group at SRI. This MAFF funded project aims to achieve a better understanding of temperature and moisture changes during storage and to provide a sound basis for the optimisation of potato storage operations. For modelling, the potato storage problem had been divided into two components, (i) heat and mass transfer in the air moving in the store, and (ii) heat and mass transfer between the potato and the air stream. Work comparing experimental results of air distribution in "letter box" walls with CFD predictions were presented. A comparison was made between experimental results from a step change in temperature through a deep bed of potatoes with a model prediction. Good agreement was shown.

In an overview of SRI work on the **Drying of grain and/or wood fuel,** Tony Walton briefly described previous work on heated and near ambient grain drying. Tony's own work was focused upon the on-farm validation of improved strategies for the control of near-ambient dryers in bulk stores. These strategies have been identified by optimization of a model of the heat and moisture transfer in a deep bed subject to time varying air conditions. A method of using the mathematical model to infer grain moisture contents from serial measurements of bed temperature could improve also the application of existing policies. With appropriate modifications, the grain drying models are now being applied to the storage and drying of wood grown specifically for fuel.

The afternoon session was chaired by Dr Stuart Gardiner, Chairman of the Solids Drying Group. He introduced Christian Ruff of the School of Chemical Engineering at Birmingham University to give a talk on **The drying of ceramic materials.** Precision ceramic components are formed by extrusion or injection moulding of paste which must then be dried without distortion or cracking before it can be fired. The results of drying trials with cylindrical billets were described. The material shrinks during the first stage of drying when moisture is freely lost from the product. Two further distinct drying phases were illustrated and the mechanisms of moisture transport and loss were discussed.

In a talk on **Airflow distribution and drying in grain beds,** Dr Edward Smith, Department of Mathematics and Statistics, University of Paisley reminded us that mathematical modelling does not always require powerful computers and can be used to simplify a problem. As an example, he demonstrated that the shape of the drying zone in a two dimensional flow model can be estimated by knowing the shape of the iso-transit time contours. This simplification provides a very effective way of investigating the shape and optimum position of air inlet and outlets in a bulk of porous material. The application of this technique to the design of an air entry into a hopper bottomed grain bin was described.

With our final speaker, Dr Bagnaro of Rhône-Poulenc Recherches, unexpectedly detained in Paris, the afternoon session was completed at short notice by another talk from Dr Dean Burfoot, this time describing some of the projects specifically related to food products. These included modelling the dispersion of airborne particles in high care factories and the microwave pasteurisation of chilled meals to extend shelf life.

*DIB, MEN*

# Fast tractors - *are you within the law?*

Advances in modern technology and engineering techniques has lead to agricultural equipment being developed and enhanced at an ever increasing rate to meet new farming challenges. The farming industry has benefited immensely with productivity levels rising and increased economies of scale. Farm materials handling has come under particular scrutiny.

One of the key influences on the development of fast tractors was the research in the 1970's highlighting that in the majority of cases well over 50 % of farm tractor activity is devoted to transportation either on the farm or the road. Before fast tractors were developed, the speed that tractors could travel was normally limited to less than 32 km/h, constrained by the gearing of the tractor, it's lack of suspension, it's braking system, and not least the law. Slow transportation speeds were obviously not always providing the most effective use of time or resource. In addition, farms have and are increasing in size, with longer distances to travel, again stressing the need for faster tractors to decrease transportation time.

The new generation of tractors were developed specifically to combat these issues, with a priority of making tractors faster, safer and more comfortable via design improvements and improving the braking system ensuring that fast tractors, which can now travel at speeds well in excess of 50 km/h, also comply with the Vehicle Use and Construction Regulations. The legislative concerns are rising, and it is crucial that farmers using or considering using fast tractors are aware of the current law as well as possible future law.

Writtle College, Essex, the UK's premier centre for land based technology, is holding a half day conference entitled **'Fast Tractors' on 6th November 1996** to discuss the above issues. The aim of the conference is to promote an appreciation of the safety, legal and technical aspects of using high speed agricultural equipment on the road and to generate a more thorough understanding of the advantages, disadvantages and limitations of such equipment.

There will be expert speakers from the Essex Police covering **legislative concerns** and Customs and Excise looking at **procedures for rebated fuel usage.** In addition a research speaker will address **tractor ride characteristics, suspension and handling,** and a trailer manufacturer will speak on the technical appreciation of the construction, **use and misuse of equipment towed at high speeds.** A tractor manufacturer(JCB) and a tractor distributor/manufacturer(Fendt) will provide a technical description of the uses, **advantages and disadvantages of high speed tractors** on the road. Finally, an actual user, the farmer, will cover the **benefits and drawbacks of using high speed tractors** and associated equipment on the road, as well as discussing running costs and maintenance. There will also be plenty of opportunity to ask specific questions of the speakers and Writtle staff.

For further information, contact: **Jenny Bulman, Writtle College, Chelmsford, Essex, CM1 3RR. Tel: 01245 420705.**

## CONFERENCE

*"FAST TRACTORS - 50 km/h and all that ....."*

| | |
|---|---|
| OBJECTIVES: | **To promote an appreciation and awareness of the safety, legal and technical aspects of using high speed agricultural equipment on the road; to generate a more thorough understanding of the advantages/ disadvantages and limitations of such equipment.** |
| DATE: | **Wednesday 6 November 1996: 1.30 pm - 6.30 pm** |
| VENUE: | **Writtle College** |
| ADMISSION: | **£25 (including VAT) [Members of IAgrE - £10; Student members of IAgrE £5; Student non-members £10]** |
| ORGANISER: | **Writtle College in association with the Institution of Agricultural Engineers.** |
| CONTACT: | **Jenny Bulman, tel. 01245 420705.** |

## Pioneering Technology report

A very encouraging start to the Pioneering Technology Specialist Group (PTSG) took place in June when fifty people of all ages made a visit to RAF Wroughton, the reserve collection of The Science Museum. The visit was organised by the West Midlands Branch and adopted by the PTSG. The members and their guests were drawn mainly from the three adjacent Institution Branches and an agricultural machinery group from Princes Risborough. The site is hidden in the depths of Wiltshire behind high chain link fencing and is open only by appointment. We had an opportunity to look at a small selection of The Science Museum's vast reserve collection held in air-conditioned aircraft hangars. We saw inside two hangars; the first covered development in aircraft and the second, the main one we had come to see, had transport and agricultural exhibits. Hangars are surprisingly large and hold an awful lot of equipment, especially when parked very close together! Exhibits included some of the very first tractors developed, showing themselves as a cross between traction engines and horseless carriages and almost everything in between. We were probably the last group to be able to visit that particular hangar as it is due to be closed soon and refurbished. The Land Technology gallery in London is due to be closed soon and relocated into this same hanger. All the existing equipment will be moved elsewhere. This may eventually lead to Wroughton being opened much more often than in the past as they have a plan to develop the site.

This was an excellent start to the Institution's newest specialist group, established in the 50th anniversary year of one of the greatest engineering leaps forward, the start of production of the TE20 tractor, the Little Grey Fergie. This meeting was also on the day that Thomas the Tank Engine was 51, another important development in the understanding of steam locomotion.

Is your branch planning a technical meeting, visit or know of an event that members will be interested in? If it covers any development of engineering importance that had, or will have a pioneering development aspect, please let me know. I will publicise the events around the Institution and interested members. Why keep a good thing to yourself?

William Waddilove
PTSG Co-ordinator

# Membership movements

| *Mem No.* | *Name* | *From* | *To* |
|---|---|---|---|
| 5208 | J F Browning | Oxon | Vietnam |
| 4364 | J M Chapman | Somerset | Avon |
| 0372 | E D Coles | Indonesia | Yemen |
| 5484 | C J Connor | The Netherlands | Lancs |
| 3253 | S J P Evans | Lancs | Dyfed |
| 6408 | A T Glazebrook | Beds | Bucks |
| 6359 | N A L Gunn | Kenya | Suffolk |
| 5274 | M E Hall | Essex | Cheshire |
| 5891 | P A H James | Hereford | New Zealand |
| 6362 | A Kaminski | Beds | Scotland |
| 4501 | C J Parker | Oman | Hampshire |
| 5760 | N C Portch | Oxon | Ghana |
| 4242 | D W Russell | Shrops | Oxon |
| 6533 | D L Sandars | Hereford | Beds |
| 2468 | D W Sawers | Somerset | Scotland |
| 6394 | I J Sayers | Suffolk | Derbys |
| 6262 | K J Smyth | Beds | Ireland |
| 4709 | M A Zobisch | Thailand | Syria |

### Gone Away

| *Name* | *Last known address* |
|---|---|
| C R Boon | Silsoe Research Institute, Wrest Park, Silsoe, Bedford MK45 4HS. |
| S Mansaray | 36 Redbridge Gdns, Southampton Way Estate, London SE5 7EZ. |
| T J Willcocks | Silsoe Research Institute, Wrest Park, Silsoe, Bedford MK45 4HS. |
| Y Wei | Process Engineering Division, Silsoe Research Institute, Wrest Park, Silsoe, Bedford MK45 4HS. |

# Branch Diary

## West Midlands Branch

Monday, 14 October **at 19.30 h**
**Leamington Spa**
***Factory visit to Ford Foundry.***
Modern engine component casting plant. Restricted number of visitors, booking and details from Branch Sec.

Monday, 21 October **at 19.00 h**
**Hindlip Hall near Worcester**
*Visit to West Mercia Police Headquarters.*
An aspect of police work, buffet supper available at £3 per person.

Monday, 11 November **at 20.00 h**
**Warwickshire College, Moreton Morrell**
*Lewis Equipment Ltd.* Ian Lewis (Director) will talk about his Company and products.

Monday, 9 December **at 20.00 h**
**Pershore College**
*Toro Turf Equipment.* David Cole (UK Sales Manager) will talk about the needs of sports turf and specialised equipment.

# Institution membership changes

## Admissions - a warm welcome to the following new members

**Member:**
D H Ebbah (Hampshire)
R B Low (Surrey)
N Toolsee (Mauritius)

**Associate Member:**
D G Crabb (Warwicks)
J A I Jayasinghe (Sri Lanka)
S A Short (Wilts)
E O F Udeagbala (Surrey)
R D Wilson (Scotland)
Q Zhou (Beds)

**Associate:**
E Armah (Ghana)
C D Grant (Scotland)
I M Lovel (Yorkshire)
H S Mazikou (Congo)
D W Wilson (N Ireland)

**Student:**
A D Gregory (Essex)
R Jackson (N Ireland)
S M Maguire (Essex)
P J Moseley (Beds)
C V T Scullane (Warwicks)
C H A Young (Surrey)

## Readmission

M D Sheldrick (Staffs)

## Reinstatement

J Summerscales (Devon)

## Transfers - congratulations on achieving a further phase of their professional development

**Fellow:**
F J Pirie (Scotland)

**Member:**
I Bown (Derbys)
J P Middleton (Kenya)
N C Portch (Ghana)
Q Zhou (Beds)

**Associate Member:**
L A Bamford (Cambs)
K J Smyth (Ireland)

## Death - with great sadness, we record the death of:

R A Davis (Berks)

## Engineering Council registrations

**CEng**
D W Hatherill (Surrey)
L Kailondo (London)
P E Steele (Italy)
P J Williams (Cambs)

**EngTech**
R W Jackson (Berkshire)
A J Parrish (Beds)
D D Smale (Cornwall)
M J Tyson (Cumbria)

# Do experts need training as witnesses?

The quality of expert evidence has been the subject of much comment in the legal press since Lord Woolf reported last year on the first stage of his inquiry into civil justice in England and Wales. Writing reports for use in court and giving expert evidence from the witness box demand skills different from those most experts acquire during the course of their professional careers, and there is growing support for the idea of formal training in these skills.

The question of training and accreditation of expert witnesses was raised again in a consultation document issued by the Lord Chancellor's Department earlier this year. As part of their aim to keep expert witnesses abreast of developments in the field, the publishers of the *UK Register of Expert Witnesses* distributed copies of the document to all 2,500 expert witnesses listed in the *Register*. Of those expert witnesses who responded to it, a clear majority agreed, but with reservations, that better training was needed for a number of reasons:

- to assist first-time expert witnesses
- to improve the skills of all expert witnesses in report-writing and giving oral evidence
- to give instructing solicitors a recognised measure of expert witness skills
- to improve knowledge of court procedures.

As well as these positive reasons, there were, however, some experts who disagreed with the idea of training because of:

- expense
- the need for time off to attend courses
- a resultant reduction in the pool of experts available.

The range of opinions voiced by the expert witnesses show the challenges facing Lord Woolf if any of his recommendations are to be implemented. It appears that training is acceptable to the majority of currently practising expert witnesses if it is at the right price, in the right location and not mandatory. Of those who had already attended a skills training course of one sort or another, the general consensus was that the training had been helpful.

For further information, contact:

**Kate Porter, UK Register of Expert Witnesses, PO Box 505, Newmarket CB8 7TF. Tel: 01638 561590.**

# News of *Members*

**Peter Redman** is now in charge of developing new business for ADAS and Peter describes his new task as follows.
"As ADAS moves increasingly towards a 'private sector' organisation, the development of new business is essential. A good deal of the expertise within ADAS, traditionally provided to farmers and landowners on behalf of MAFF is equally applicable to other Government Departments and their agencies, and to Local Government Authorities. ADAS also has a role in providing research and information which contributes to the strategic planning of these organisations. The 'portfolio' of customers - including all the Central Government Departments other than MAFF, all the Agencies, the Research Councils and Local Authorities - is as very varied as are their needs. Although I am very dependent on the support and knowledge of colleagues, the range in experience which comes from a background in agricultural engineering is invaluable." Thank you Peter for this information and I wish you well in your new role.

Congratulations to **Allan Kaminski** who graduated with a First Class Bachelor of Engineering degree from Silsoe College on the 10 July, 1996. Allan is now a Training Instructor with Massey Ferguson in Warwickshire.

**Ian Sayers** left Newcastle University in July 1994 with a BEng Agricultural Engineering and went to the USA to join a John Deere custom harvesting team until Christmas 1994, cutting various crops across Kansas and Texas.
When the harvest finished, he went to work in central Ohio for the largest John Deere dealership in the US, where his work involved trouble-shooting of John Deere combines and tractors, and some development work with the new John Deere GPS system, which is due for release this year. He has now returned to England and is working as a design engineer for JCB Excavators in the Loadall division.

**G R Rowlinson** is now Dewatering Superintendent on a cut and cover tunnel as part of the airfield infrastructure in Hong Kong, which is at present the biggest civil engineering job in the world. He is responsible for about 1900 kVA of power moving 270 cubic metres of water per minute and has a labour force of 20 which includes electricians, fitters and labourers.

Congratulations to **Philip Kojo Afful** who has been given a Gold Award by the Association for Colleges. These Gold Awards are awarded by the Association for "outstanding individuals, part of whose education has been in a further education college". The nominees are all individuals "for whom FE was a significant part of their learning experience and who have gone on to achieve excellence in their chosen field of activity." Philip was nominated by Rycotewood College where in 1990 he obtained a BTEC Higher National Certificate in Agricultural Engineering and is now a refugee worker. He is the Water and Sanitation Co-ordinator responsible for all water and sanitation aspects in North Eastern Kenyan Desert refugee camps which house 120,000 refugees. Philip has worked for a wide variety of charities and non-governmental organisations including: The European Community, Oxfam, Overseas Development Administration and CARE International. He was seconded to the European Community Task Force in 1993, as part of an emergency team of engineers, to repair basic public utilities in areas of Central Bosnia. His work included making technical assessments of district heating, water, sewerage, and power network systems. In recognition of this work he was awarded the MBE in the 1995 New Years Honours List.

**Douglas M Walker** a past President of this Institution has been elected as a Fellow of the Council for Awards of Royal Agricultural Societies. As many of you will know, Douglas retired as Managing Director of John Deere in the UK in 1993 and is now Chairman of the Douglas Bomford Trust and a Visiting Fellow at Silsoe College.

**Lewis G Campbell** retired from the World Bank in July 1995 and has relocated to Barbados where he is looking forward to continuing an active life while enjoying a very pleasant environment. Among the many things that he is expecting to pursue are caring for a fruit farm orchard, mainly mangoes, and indulging in hobbies such as woodworking and writing. However, in between these activities he will be making available his professional skills in rural development and sustainable management of natural resources in tropical and sub-tropical areas. Recently he has been doing some of this in Africa with the World Bank, but he is hoping to broaden his geographic coverage as well as the range of organisations which would wish to use his services. Lewis says that if any members of the Institution are visiting Barbados he would be pleased to meet them and extend some hospitality. He also says that if any organisation requires a consultant with his skills he would be pleased to hear from them. Lewis's address is Argyle Lodge, 15 Sturges, St. Thomas, Barbados, West Indies.

*AAWC*

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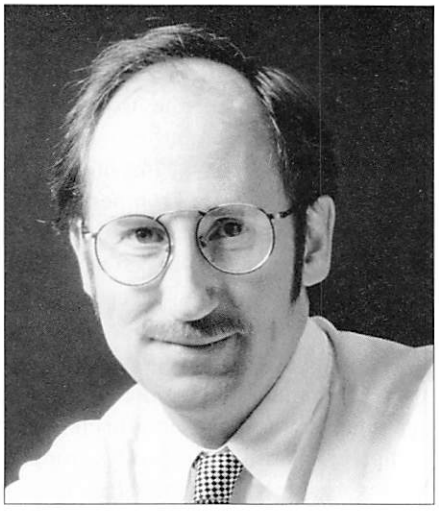
Printed by: Barr Printers, Glenrothes



# Impact of computers on horticultural crop production

**Robin A K Szmidt**

## Introduction

Computers have been widely used in production horticulture for some years. The first point at which these were employed were in-house environment control, commercially from the early 1980s. A number of companies produced dedicated equipment. At the same time a small number of growers with a particular enthusiasm for computers designed their own systems based on early home-computers. Such developments, and indeed the rationale behind the control algorithms is well documented elsewhere (Burrage, 1982).

The use of computers in production horticulture is no longer restricted to greenhouse environment control. Indeed, as with all walks of life, computers play an every day part in modern horticulture.

In addition to control of the cropping process itself, particularly for protected crops, computers are important in input-management, information gathering and therefore meeting outlet and consumer demands. The role of computers in decision support was recently reviewed by Doyle *et al.* (1995). These authors concluded that while computers are increasingly capable of assisting decision support analysis such options are seldom exploited in UK horticulture. Demand has largely been for data recording or stock control protocols, predominantly based on spreadsheet packages. Nonetheless, computers play an increasingly important role in crop production and management. Examples of where computer technology has developed strongly and possible trends for the future are described below.

***This paper was presented at the IAgrE conference entitled: "Fruit and vegetables - chasing quality", organised by the Scottish branch and held in Perth on 21 February 1996.***

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## Crop-environment control

In the most basic of greenhouse control systems, ventilation and heating are regulated to achieve a set point around which environment control systems must regulate heating or ventilation within acceptable limits. The concept of cropping programmes such as the ADAS tomato blueprint of the 1970s and 80s was to achieve "steady state" conditions (Anon, 1983). For instance, if a temperature of 18°C was targeted then this was the limit to which the control system should be designed. Such "steady state" control can be satisfactorily achieved using analogue controllers, such as Proportional Integral Derivative (PID) systems. Control ± 1°C is readily attainable with such systems and regulation of temperature and ventilation can meet all targets. Nonetheless, computer systems offer a wider range of opportunities than are feasible with analogue controllers. For instance, the rate of change within the greenhouse between certain environmental "zones", such as day to night, can be altered using computers. This is not possible using conventional systems. External climate has a very great influence on the internal environment within even the best sealed greenhouse. From the early days of greenhouse computer design the value of using external meteorological data to predict coming change within the glasshouse was understood. All systems currently marketed offer the choice of an external meteorological unit which will be used in decision making for the internal climate. This ability to predict change is not possible with conventional analogue systems.

As crop biology developed, a wider range of parameters were sought for control, typical examples being control of carbon dioxide *(Figure 1)*. With the advent of raised daytime carbon di-

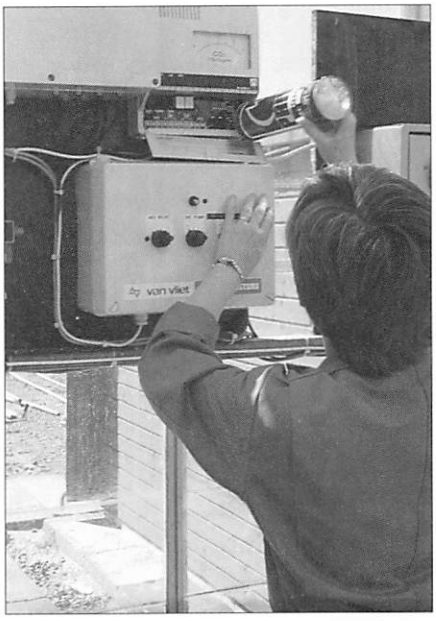

**Fig.1 Calibration of an Infra-red Gas Analyser (IRGA) monitoring greenhouse carbon dioxide levels and interrogated by computer controller.**

oxide levels, interaction with the control system was essential. This was not the case with previous techniques of night time supplementation where ventilation and heating were working to steady targets (Hand, 1989).

The ability to manage a number of interacting systems brought the use of computers to the fore. A good example was in the use of thermal screens where simple mechanical switching to open these in variable ratios depending on internal or external climatic factors. Systems may be adjusted on the basis of uptake of fertilisers and water, internal greenhouse humidity and temperature, as well as external factors such as solar radiation. Computing potential outstrips what is currently done and a number of companies have looked at the possibility of controlling irrigation and nutrition on the basis of single ion measurement.

RESULTS G R E E N H O U S E C H A R A C T E R I S T I C S | HORTICERN

| VOLUME [m3]: 266.3 For average conditions | AREA [m2] | THERMAL LOSS COEFFICIENT Without screen U value grnd m2 [W/m2K] | k'value env. m2 [W/m2K] | [%] | With screen U value grnd m2 [W/m2K] | k'value env. m2 [W/m2K] | [%] | SOLAR COLLECTION a col [-] | [%] |
|---|---|---|---|---|---|---|---|---|---|
| TOTAL | 205.2 | 27.7 | 12.8 | 100 | 20.8 | 9.7 | 100 | 0.59 | 100 |
| Roof | 116.1 | 6.4 | 3.0 | 23 | 4.0 | 1.9 | 19 | 0.03 | 5 |
| Sides | 89.1 | 4.0 | 1.8 | 14 | 3.0 | 1.4 | 14 | 0.00 | 0 |
| Ground | 95.1 | 0.8 | 0.4 | 3 | 0.8 | 0.4 | 4 | 0.56 | 95 |
| Air leakage | | 16.5 | 7.6 | 59 | 13.0 | 6.0 | 63 | | |

RESULTS | P O W E R E S T I M A T I O N | HORTICERN

| | INSTALLED POWER Without scr | With screen |
|---|---|---|
| Total [kW] | 57.4 | 42.3 |
| per ground m2 [W/m2] | 603.3 | 444.6 |

Data for estimation

Inside temp[°C] : 25.0
Outsid.temp[°C] : 0.0
Sky temp. [°C] : -25.0
Windspeed [m/s] : 7.4

RESULTS | M O N T H L Y B A L A N C E W I T H S C R E E N | HORTICERN

| Month | Tot durat Days | Gross needs MJ/m2 | Energ. col. MJ/m2 | Elect. contr. MJ/m2 | Energy reject MJ/m2 | Energy recov. MJ/m2 | Used energy MJ/m2 | Nett needs MJ/m2 | Energy consump MJ/m2 | Energy consump. Nat.gas m3/m2 |
|---|---|---|---|---|---|---|---|---|---|---|
| JAN | 31 | 448.7 | 29.7 | 0.0 | 28.4 | 28.4 | 1.2 | 447.4 | 655.2 | 18.1 |
| FEB | 28 | 353.8 | 65.2 | 0.0 | 64.1 | 64.1 | 1.1 | 352.7 | 524.0 | 14.4 |
| MAR | 31 | 390.9 | 117.8 | 0.0 | 116.6 | 116.6 | 1.2 | 389.6 | 579.0 | 15.9 |
| APR | 30 | 284.0 | 219.4 | 0.0 | 218.2 | 218.2 | 1.2 | 282.8 | 436.0 | 12.0 |
| MAY | 31 | 203.3 | 281.8 | 0.0 | 280.5 | 202.1 | 1.2 | 202.1 | 331.5 | 9.1 |
| JUN | 30 | 125.4 | 274.0 | 0.0 | 272.8 | 124.2 | 1.2 | 124.2 | 226.6 | 6.2 |
| JUL | 31 | 73.0 | 267.5 | 0.0 | 266.3 | 71.7 | 1.2 | 71.7 | 159.5 | 4.4 |
| AUG | 31 | 69.3 | 216.7 | 0.0 | 215.4 | 68.0 | 1.2 | 68.0 | 154.6 | 4.3 |
| SEP | 30 | 182.7 | 136.2 | 0.0 | 135.0 | 135.0 | 1.2 | 181.5 | 302.3 | 8.3 |
| OCT | 31 | 232.7 | 75.6 | 0.0 | 74.3 | 74.3 | 1.2 | 231.5 | 370.3 | 10.2 |
| NOV | 30 | 321.5 | 36.0 | 0.0 | 34.8 | 34.8 | 1.2 | 320.3 | 485.5 | 13.4 |
| DEC | 31 | 406.5 | 21.7 | 0.0 | 20.5 | 20.5 | 1.2 | 405.2 | 599.5 | 16.5 |
| YEAR | 365 | 3091.7 | 1741.7 | 0.0 | 1727.1 | 1158.0 | 14.6 | 3077.1 | 4823.9 | 132.9 |

**Fig.2 Typical computer generated output of energy balance for a simulated greenhouse.**

screens in the morning resulted in the "dumping" of relatively cold air on to crops with resultant problems. Computers are able to operate screens on a proportional basis and so change rate of screen opening depending on current conditions.

To some extent the advance of the mechanical systems and computer potential was outstripping understanding of crop biology. While conventional analogue systems are able to control quite well around a target, computer systems give the choice of optimising rather than targeting conditions. The question is what exactly is that optimum at any given time?

The same situation applies in regard to irrigation control. Sophisticated computer systems are available for the control of irrigation systems, able to adjust not only pH, conductivity and selection of stock solutions but also to mix

While such sensors are available, they are rarely sufficiently robust for industrial use and this is an area of significant future potential.

As with environment control, irrigation control technology has potential which has not yet been exploited, because of a lack of understanding of all of the biological interactions between the plant and its environment.

The mushroom industry offers specialised opportunities for control using computer systems. Compost production is a complex microbiological and physical process which requires sequencing of air-mixing, temperature control and, possibly, humidity regulation. The process is very greatly influenced by small changes in physical environment, and the overwhelming majority of modern installations use microprocessor control. Nonetheless, as with plant biology, compost biology is not fully understood and the composting process may vary, as are the raw materials used in the process, depending on time of year. As such, the skill of the programmer has to be overlain by the skill of the composter.

With regard to the mushroom crop itself the growing environment should perhaps be closer to the steady state of a blueprint with the crop aimed to be fixed at any particular point in the cropping cycle. Nonetheless, the cycle itself is split into a number of control periods which will vary for individual strains and so once again the environment lends itself well to computer control. Inevitably, cropping houses are subject to external factors, such as inlet of air following door opening and crop picking. Computer systems should be reactive to overcome any such change.

With the ability to optimise conditions must come the programming, sensor and control systems to work to specific conditions. Now that these are widely available, this has opened up the possibility of imposing novel crop production techniques. A good example is the DIF technique, promoted by the Horticultural Development Council (HDC) where major, but short-life, changes in environment can give growth-regulating effects for plants. This offers the possibility of non-chemical growth regulant control (Langton, 1994). Similarly, the pattern of flushing for mushrooms may be modified using short-life high temperature treatments within the cropping environment (Anon, 1984). Conventional systems were unable to satisfactorily control this but modern computer technology makes this perfectly feasible.

## Facilities design

Computer systems offer modern horticulturists a wide range of design systems. Many of these can be simulated by computer before high capital investment. Examples include lighting system design, heating system design and the structures themselves. This applies equally to new installations as it does to retro-fitting. Design programmes are widely used by advisers to help choose options in energy management. Programmes such as Horticern (©The Solar Energy and Buildings Physical Laboratory, Lausanne) can be routinely used to assess the cost-benefit of installation of thermal screening or major reinvestment such as glasshouse recladding *(Figure 2)*. Comparative systems have to be tailored to local conditions, taking account of local meteorologi-

cal and climatic conditions, and therefore are generally restricted to specialist use. Nonetheless, they regularly prove themselves cost effective. In one example, a review of energy management on a nursery revealed that one house, accounting for 10.2% of the floor area, represented in excess of 33.2% of the energy consumption. The management programme of the nursery was changed to utilise this house for low-input crops and substantial energy savings made.

## Robotics

Many production operations, such as seed sowing, are routine and mechanical and can be readily automated. Where processes are carried out in sequence, they may benefit from microprocessor and therefore computer control. Examples where robotics have the greatest potential are those which are repetitive and require unskilled labour. Those where decision making, such as selection for harvesting, is required can potentially be subject not only to automation but to comprehensive robotics, providing that adequate recognition sensors are available. An example where such systems can be readily employed is in the micropropagation industry. It has been recognised that the complexity of man-management on what are fundamentally routine selection tasks often prove to be a block to expansion of businesses. Currently costs of full robotic systems are prohibitive and there is a technology gap where manually operated businesses struggle to compete on a large scale, while full robotic systems can only be effectively costed for much larger operations. There is currently therefore a difficulty in businesses expanding from manual to robotic operations. Nonetheless, extensive research has been carried out in this area, not widely in Europe but principally in Japan.

In terms of selection of crops for harvesting by robotic systems, the most likely system to first reach the market place is that of mushroom harvesting. This is an attractive system in that white mushrooms can be relatively easily recognised by image analysis against the dark background of the growing medium. Selection of mushrooms to be harvested and the order of harvesting is carried out by a "smart" system, programmed to maximise quality of harvested products. This system has been developed by MAFF funded research at Silsoe in conjunction with Kensal Automation Limited (Legg, 1995). The mushroom crop is also attractive in that it is two dimensional with harvesters operating only on a single horizontal plane. By contrast, crops such as tomatoes, while technically harvestable by robotic systems equipped with colour recognition, demand mechanics capable of operating not only in two dimensions horizontally but also in the vertical plane.

With regard to field-grown crops some bed systems lend themselves to culture using gantry systems rather than tractor-drawn implements. As a general rule, however, operations continue to be carried out on an otherwise conventional basis.

Cultural systems within greenhouses may be particularly complex, such as moving-table systems where complete units of pot plants are transported within greenhouses. Crops are moved through a range of environmental conditions, such as daylight to artificial light zones. This may be fully automated and the entire crop handling system computerised in addition to the computerisation previously discussed for environment and irrigation control (Stolze, Meulenbelt & Poot, 1985).

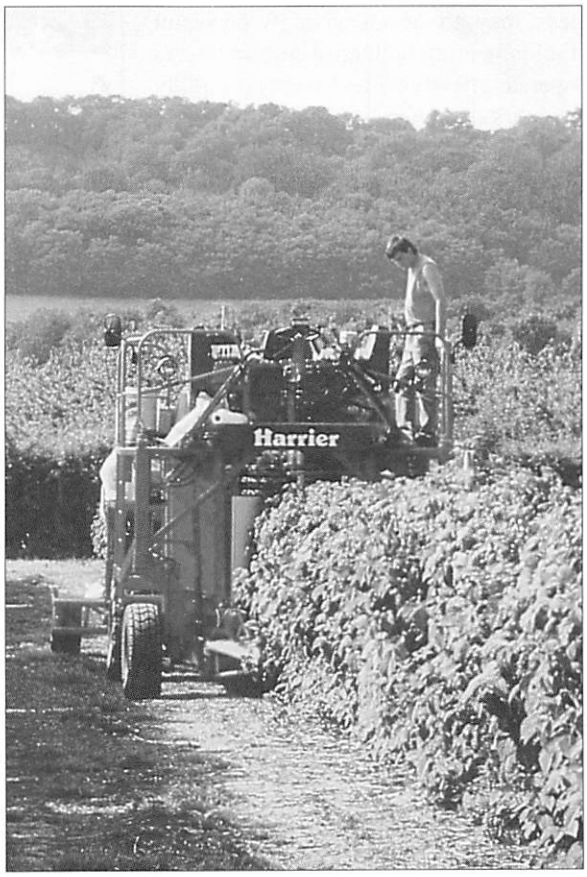


**Fig. 3 Find your way in the raspberry maze by satellite location?**

## Crop assessment

The advent of compact data recording systems offers the potential for fieldsmen and advisers to continually log the quality and pest and disease incidence of crops. Systems are becoming available which can be used to enter such data on a moment by moment basis during crop inspections. By allocating zones within the crop, the progress of pest and diseases or closeness to harvest can be logged. Such data can then be downloaded on to a personal computer. Programmes are available which will then compare previous readings for the same crop and generate a predictor for the spread of pest and disease or the predicted harvest date. This on the one hand gives a greater accuracy to pesticide applications, and therefore minimisation of pesticide use. At the same time, predicting maturity of the crop will improve targeting of markets and customer liaison. The way in which individual locations for such pest and disease recording can be made within a glasshouse is relatively straightforward by identification of pathways or bays. On a large field scale, this may not be so straightforward. In this case, hand-held satellite location systems can assist. Equally, satellite tracking of individual tractors or implements can be readily envisaged *(Figure 3)*.

## Information Technology

Increasingly, information for growers is computer based. In most of the main marketing organisations in Europe, the pricing and information on availability and quality of produce is handled by computer. In many cases, market information is directly accessible by the growers through their own office computers. Buyers and sellers, perhaps hundreds of miles away, may be able to interrogate the stock list of suppliers, even of individual growers. Such systems are only as good as the accuracy of the information entered into the system. Nonethe-

less, they are an increasingly powerful tool in helping both growers and buyers operate effectively and respond rapidly to market demands. It is completely likely in future that major markets, such as the Dutch auctions, will be tied to predictive computer programmes which may generate a "futures market" in horticultural produce, allowing the grower to programme and target crops more accurately.

As with all sectors of the community, ready access through home and office computers to the Internet has opened up considerable potential for all types of crop and management information. Whereas in the past an adviser's role was one of providing specialist advice to a relatively uneducated industry, it could be argued that today's adviser has a specialist role in helping growers sift what is an otherwise overwhelming amount of information which is easily misinterpreted.

**Acknowledgements**

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# Back to the future at 'The Royal'

Students attending The Royal Agricultural College, Cirencester will soon have the opportunity of studying for an agricultural degree with land management, equine studies and agribusiness options, and complete a six-month sandwich, all within a three-year course.

Speaking about the introduction of the new degree course, Gerry Lane, Senior Lecturer in the School of Agriculture, said: "Research into student applications over recent years has shown a strong demand for basic agriculture as well as more diversified courses, while many employers are also seeking graduates with wider agricultural knowledge and some practical experience."

With the new modular design of degree courses, the College can now respond quickly to new requirements, and from October will run a new BSc(Hons) degree in agriculture. This will make use of existing modules, but with some important enhancements in the areas of agricultural policy, animal health and welfare, and farm mechanisation management. In addition, in the final year, a fully integrated farm study will bring all elements of the course together, when students are asked to assess and draw up detailed plans for a totally unfamiliar farm situation.

Offering agricultural qualifications is nothing new to the College, but as Dr John Alliston, Dean of the School of Agriculture, explains, two features will make this new course unique. "Firstly, students will get an excellent course in general agriculture, with the provision in the second and third years to specialise in farm management, farm mechanisation, crop production or animal production.

"By bringing the second year examinations forward to just after Easter, we also allow time for a six month sandwich work placement. Students favour this arrangement as they benefit enormously from the experience of sandwich employment, while still completing their degree within three years. The flexibility of the programme means that we can also cater for students who would prefer a full year out, or for the very experienced students who require no sandwich period at all!"

Concluded Dr Alliston: "Students at the Royal Agricultural College particularly benefit from what we call the 'Cirencester experience' - the opportunity to really enjoy themselves while studying for a worthwhile qualification. Based around a relatively small campus, they feel part of a community which embraces a wide range of sports played to a very high standard, as well as an excellent social life."

Details of the new degree in agriculture can be obtained from: **The Registrar, The Royal Agricultural College, Cirencester, Gloucestershire, GL7 6JS. Tel: 01285 652531.**

# New £8 million LINK research programme

The Ministry of Agriculture, Fisheries and Food and the Biotechnology and Biological Sciences Research Council today announced a new £8 million LINK research programme - Competitive Industrial Materials from Non-Food Crops - aimed at developing uses for renewable raw materials from crops.

MAFF expects to contribute £1 - 1.5m and BBSRC £2.5m over five years, funds which will be matched by industry sponsors. The initiative is also supported by the Scottish Office, DTI and EPSRC on an ad hoc basis.

The aim of the programme is to increase the use of crop-derived materials across a wide range of industrial sectors. There is significant potential for economic and environmental benefits, through import substitution of raw materials and reduced use of non-renewables like fossil hydrocarbons.

The programme will stimulate research to encourage the development and uptake of raw materials produced from crops, such as fibres, starches and oils. Individual projects will tackle the factors affecting uptake, whether economic or supply-chain issues, concerns about quality and availability, or differences between crop-derived and conventional feedstocks.

Projects in the programme are expected to involve multidisciplinary

teams ranging across the life, physical and engineering sciences and to be focused on end-user needs. Plant biotechnology and biochemistry, biochemical and process engineering, chemistry, materials science and materials processing, and lifecycle analysis or process modelling will all be strongly represented.

MAFF and BBSRC are calling for outline research proposals which meet LINK criteria and which address the programme's aims. There is particular interest in enabling technologies relevant to medium to high value product opportunities in the oil, fibre, carbohydrate and speciality chemical sectors.

The Programme Co-ordinator is Mr Ian Bartle, Tel. 01243 538896, and the Secretary is Mr Mike Matthews, Silsoe Research Institute, Wrest Park, Silsoe, Bedford, MK45 4HS, Tel: 01525 860000.

# Food safety clearance for narrow-leaved lupin seeds

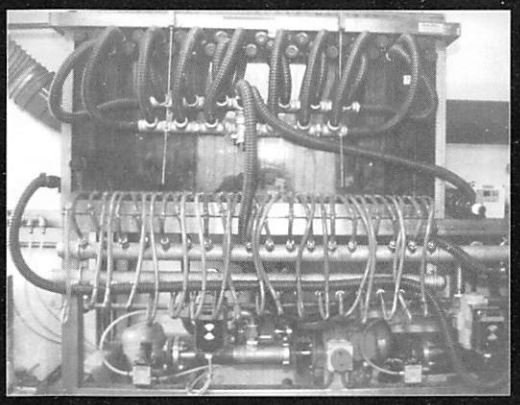
The Government has accepted advice from the Advisory Committee on Novel Foods and Processes (ACNFP) and has given food safety clearance to seeds from the narrow-leaved lupin *(Lupinus angustifolius)*.

Lupins have been used elsewhere in the world as a human and animal food for many centuries. The seeds of most varieties contain high levels of alkaloids which give them a bitter taste. *Lupinus angustifolius* has been developed as a low alkaloid "sweet lupin" that still retains the high protein content of original varieties.

The seeds may be consumed whole, or as flour, protein concentrate, dietary fibre, or in fermented products in place of soya beans.

There have been occasional reports of allergic reactions to lupin products in a small number of cases in countries where such products are already available. Whilst the potential for allergic reaction does exist, the proportion of the population likely to react was considered to be less than that reacting to existing food allergens including other legumes, with any reactions being similar to those produced by foods such as soya.

# New decontamination technology wins top EU environmental award



**One of two electrolysis cells of Soils NV's mobile bipolar**

A Belgian company's innovative technology for removing heavy metals from contaminated groundwater has attracted a top European environmental award. Decontamination specialists Soils NV received the "Cleaner Technologies" award from Irish President Mary Robinson during the 1996 European Better Environment awards ceremony at Dublin Castle on July 15.

Soils NV became a finalist in this EU-wide competition in March, on winning a national award for a bipolar electrolysis technique for removing heavy metal contaminants. The technology was employed for a challenging groundwater decontamination project in Lokeren, Belgium. Excellent heavy metal recoveries were achieved and, as a result, this technology is to be used to deal with other contaminated sites across Europe.

Meanwhile, Soils NV technologists are developing new bipolar electrolysis systems for industries generating effluents with high concentrations of heavy metals. These systems feature specially constructed electrodes (membrane separation) together with novel electrolysis cell geometry - a combination capable of removing heavy metal contaminants from water with great efficiency. The decontamination systems can be "tailored" to deal with specific heavy metals, such as copper, cadmium, zinc, lead, iron and nickel. These metals are precipitated as hydroxides. Mercury is precipitated as a carbonate.

The Lokeren site was heavily contaminated with mercury. A mobile bipolar electrolysis unit was constructed and housed in two 6 m containers. They achieved a residual mercury concentration in treated groundwater below the relevant European standard (1 microgram/litre).

The Lokeren decontamination work was completed in September 1995. Since then, the Soils NV's R&D team has made rapid progress in developing the technique. Stany Pensaert who led the Lokeren team says: "We now achieve even higher recoveries at very low energy consumption rates. As a result, we are designing a wide range of wastewater decontamination and treatment systems for the textiles industry and other sectors."

Industry-specific projects now under way include:

- textiles - design of a wastewater treatment system harnessing bipolar electrolysis for the removal of sulphates;
- textiles printing - a system for wastewater decontamination which is capable of removing heavy metals and organic zinc and copper pigment residues in one treatment cycle;
- galvanic plating - design of a system utilising bipolar electrolysis for the removal and recovery of copper from washwater;
- waste management - an in-situ technique for removing arsenic from landfill leachates;
- farm wastes - a simple system for reducing the copper content of pig farm wastes, already with designs for a low-cost and robust reactor suitable for farm use.

Contact: **Luc Ponnet, Soils NV, Haven 1025, Scheldedijk 30, B-2070 Zwijndrecht, Belgium. Tel: + 32 3 250 55 11.**

# Compounds aggressive to concrete floors in pig houses

**Nele De Belie, Benny De Blaere, Reinhart Verschoore**




## Abstract

Attack of concrete floors in pig houses by aggressive substances present in meal/water mixtures and manure can result in animal injuries and early failure of floor slats. To determine which components are responsible for the attack, the souring of meal/water mixtures was monitored and samples were taken on the floor in pig houses. The results show that the formation of acetic acid and mainly lactic acid causes a decrease of the pH in a meal/water mixture of 2 or 3 days old. In samples on the floor also mainly lactic and acetic acid were found, as well as other volatile fatty acids in smaller amounts and the aggressive ions $NH_4^+$, $Mg^{2+}$, $Cl^-$ and $SO_4^{2-}$.


***This manuscript was first submitted on 12 May 1996 and accepted in revised form on 24 July 1996 for publication as a refereed paper.***

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## Introduction

Concrete is a material well suited for agricultural construction and frequently used for floors in animal houses. This does not mean, however, that it is unaffected by the aggressive environmental conditions often occurring there. Chemical components from feed residues and manure may attack the concrete floor surface. This unstable surface material is removed by mechanical impact from animals and high-pressure cleaning. The coarse aggregates are exposed, and the increased concrete roughness and enlarged gap between slat beams can result in animal injuries, discomfort and lameness (Baxter, 1984; Bockisch & Schwarz, 1988). The attacked and rough surface is hard to clean which encourages the transmission of diseases. The removal of the original floor surface which had controlled characteristics (not abrasive, but also not slippery), together with the cleaning problem, also may result in a slippery floor surface. In a further stage, the attack may even cause failure of slat beams.

The attack of concrete floors is especially severe near the feed and water supply. The closer water and fodder are, the faster the deterioration progresses. Therefore, the use of wetfeeders with a nipple drinker in the feed trough or liquid feed prepared by a farmer makes the problems significantly worse *(Figure 1)* (De Belie, 1994). A better knowledge of the aggressive environment could help us to choose better concrete compositions, surface layers or protective coatings. The objective of the current work was to determine the aggressive chemical substances present on floors in houses for fattening pigs. This will allow us to formulate simulation liquids in order to test different concrete samples for their resistance.

## Compounds aggressive to concrete

The only cement currently used for slatted floors in Belgium, and also the cement mostly used for solid floors, is ordinary portland cement CEM I 42.5 (Belgian Standard NBN B12-001, based on the draft of the European EN 197-1). The most important minerals in portland cement are the calcium silicates $3CaO.SiO_2$ and $2CaO.SiO_2$, the calcium aluminate $3CaO.Al_2O_3$ and the tetracalciumaluminoferrite $4CaO.Al_2O_3.Fe_2O_3$, in concrete chemistry abbreviated as $C_3S$, $C_2S$, $C_3A$ and $C_4AF$, respectively. Especially $C_3S$ and $C_2S$, accounting for 70 to 80% of the cement constituents, contribute to concrete strength by forming calcium silicate hydrates during the hydration process:

$$2(3CaO.SiO_2) + 6\,H_2O \Leftrightarrow 3CaO.2SiO_2.3H_2O + 3\,Ca(OH)_2$$

$$2(2CaO.SiO_2) + 4\,H_2O \Leftrightarrow 3CaO.2SiO_2.3H_2O + Ca(OH)_2$$

**Fig. 1 Deterioration of concrete slats in front of a wetfeeder.**

The formation of free lime ($Ca(OH)_2$) contributes to the high pH in the concrete pores (pH=13-13.5). It also contributes to the strength of the concrete because it occurs principally as a solid, crystallized on the pore walls (De Ceukelaire, 1992). This $Ca(OH)_2$ is also very important when the chemical resistance of concrete is considered because it reacts easily with several acids and salts penetrating the concrete.

The neutralization reaction between acids and the free lime creates more or less soluble calcium salts, depending on the acid. Lactic and acetic acid, which according to the experiments are found in high concentrations on floors in pig houses, have very soluble calcium salts that can easily be washed away. The concrete porosity increases and the pH in the pores decreases. The hydrates of the hardened cement paste become unstable and start decomposing. The concrete loses its strength and disintegrates. For weak acids, such as lactic and acetic acid, the acceptable pH limits are higher than for strong acids (Bayoux *et al.*, 1990). Weak acids have a small tendency to lose protons ($H^+$) and are therefore less than 100% dissociated in dilute water solution (Mortimer, 1986), so they must be present in a higher (more aggressive) concentration to produce the same amount of $H^+$ ions and give the same pH as strong acids (pH = - log [$H^+$], where [$H^+$] = concentration of $H^+$ ions).

The salts of $Mg^{2+}$, $NH_4^+$, $NO_3^-$, $SO_4^{2-}$ and $Cl^-$ also react with the free lime of the concrete and probably produce a quite soluble calcium salt, e.g.:

$$MgCl_2 + Ca(OH)_2 \Leftrightarrow CaCl_2 + Mg(OH)_2 \text{ (solid)}$$

$$2\ NH_4Cl + Ca(OH)_2 \Leftrightarrow CaCl_2 + 2\ H_2O + 2\ NH_3 \text{ (gas)}$$

$$2\ NaNO_3 + Ca(OH)_2 \Leftrightarrow Ca(NO_3)_2 + 2\ NaOH$$

As $Mg(OH)_2$ is insoluble and $NH_3$ is volatile, these products are withdrawn from the chemical reaction occurring in the pore solution of the concrete. Therefore, the reaction will not come to an equilibrium, unless one of the reacting elements is completely used. Chlorides can also cause corrosion of the reinforcement of slatted floors, among other things because they degrade the thin but tight layer of iron oxide, protecting the reinforcement. The corrosion products (rust) have a much larger volume than the iron itself, causing stress and cracks. Moreover, calcium sulphates present in the feed residues and manure or formed in a cation exchange process with $Ca(OH)_2$ can be the origin of expansive components. The vulnerable element is the $C_3A$ of the cement, which reacts with $CaSO_4$ to form the quite insoluble ettringite $3CaO.Al_2O_3.3CaSO_4.32H_2O$. The ettringite causes internal pressure in the concrete because of the large amount of $H_2O$ molecules in its formula, resulting in cracks (Neville, 1973 ; Biczok, 1972).

## Materials and methods

### Experiment 1

Firstly, the souring of mixtures of pig meal and water was monitored. Four different meals (three for pigs and one for piglets) were mixed with water in a water/meal proportion of 2/1 for pig meal and 2.5/1 for piglet meal. Pigs and piglets normally take their feed and water in these proportions. For the piglet meal and for one pig meal, the mixtures were made in duplicate. The remaining two pig meals were considered as a control over the influence of the pig meal producer. The mixtures were kept in closed containers, and the pH values and samples were taken daily. In these samples, the fermentation process was stopped by adding concentrated $H_2SO_4$ till the pH had become lower than 2. The filtrate was separated from the dry matter by 10 minutes centrifuging at about 30000 g and filtering the liquid phase on paper filters. The concentration of lactic acid in the filtrate was measured with the Conway micro-diffusion method and the concentrations of volatile fatty acids were determined by gas chromatography. After 8 days, the measurements were stopped because there was no further decrease in pH and several mixtures began to go mouldy.

### Experiment 2

Secondly, some samples were taken in pig houses from the drinking bowl, from the wetfeeder and from the floor in front of the dry- or wetfeeder. The location of the samples is described in *Table 1*. The samples from the floors contained both feed residues and manure. All samples were measured for pH, dry matter content and concentrations of lactic acid, volatile fatty acids, $NH_3$-nitrogen, and the ions $Cl^-$, $SO_4^{2-}$, $Mg^{2+}$ and $NO_3^-$. The analyses were made in duplicate.

The pH of the samples with high dry matter content from the floor was measured after mixing the ovendry samples with water in a proportion of 1/5 (a method also used for soils).

The concentrations of the acids were measured as for experiment 1 and the concentration of $NH_3$-N was measured with the Conway micro-diffusion method. These measurements were carried out on the filtrate, obtained by centrifuging a sample of 20 gram at about 30000 g during 10 minutes and filtering the liquid phase on a paper filter.

The samples with higher dry matter content from the floor were diluted with distilled water and mixed thoroughly before centrifuging.

The concentrations of the ions were measured with ion-chromatography. The analyses were made on the liquid phase of the centrifuged and filtered material for the samples from the drinking bowls. The samples from the wetfeeders and from the floors were dried and ground and the analyses were made on the water extract, separated also by centrifuging and filtering.

All results were converted into the concentrations in the fresh samples.

## Results and discussion

### Experiment 1

In *Figure 2*, the average course of the pH and the concentrations of lactic and acetic acids are presented. In meal/water mixtures of 2 or 3 days old, the pH suddenly decreases to reach, after 4 days, a pH-value below 4.5 which is very aggressive to concrete. This can be explained by the increasing amount of lactic and acetic acids in the mixture, up to 31.0 mg lactic acid / ml filtrate (22.1 mg/g fresh sample) and 3.1 mg acetic acid / ml filtrate (2.1 mg/g fresh sample). Other volatile fatty acids only occurred in very small concentrations. The lowest pH-value measured in some of the mixtures was 3.8. This is hardly surprising because the hydrolysis-fermentation of mixtures containing mainly carbohydrates (sugars, starch, cellulose,...) normally produces organic acids and the pH, when not controlled, will drop to a level in correspondence with the $pK_a$ of the acids formed (for lactic acid : $pK_a$ = 3.86 at 25°C) (Verstraete, 1993).

### Experiment 2

In *Table 1*, the dry matter content, pH and concentrations of aggressive substances in the samples are presented. The pH was never below 5 (moderately aggressive to concrete), but this might be because neutralization reactions had already taken place. Also the complexity of the chemical environment should be taken into account (influence of all feed and manure components present).

The concentration of lactic acid in samples taken from the drinking bowl or wetfeeder was small. In the sample taken on the floor in front of the wetfeeder, the concentration could amount to 22 mg/g fresh sample (33 mg/ml liquid phase). In front of dryfeeders, concentrations of lactic acid up to 16 mg/g fresh sample (29 mg/ml liquid) were recorded. These concentrations occurred in the previous tests after about 4 days acidifying of a meal/water mixture.

The concentration of acetic acid amounted to 5.8 mg/g in one drinking bowl, where the water was quite filthy. In the other drinking bowl and in the wetfeeders, the concentration stayed below 0.5 mg/g, which is comparable

**Table 1 Analysis of samples taken in houses for fattening pigs (concentrations in mg/g fresh sample).**

| Location | DM, % | pH | Lactic acid, mg/g | Acetic acid, mg/g | Propionic acid, mg/g | Isobutyric acid, mg/g | Butyric acid, mg/g | Isovaleric acid, mg/g | Valeric acid, mg/g |
|---|---|---|---|---|---|---|---|---|---|
| in drinking bowl | | | | | | | | | |
| (+/- clear water) | 0.3 | 7.35 | 0.02 | 0.40 | 0.18 | 0.00 | 0.14 | 0.00 | 0.00 |
| (dirty water) | 4.0 | 8.33 | 0.12 | 5.85 | 1.67 | 0.07 | 0.41 | 0.00 | 0.00 |
| in wetfeeder | 26.6 | 5.2-5.9 | 0.14 | 0.28 | 0.04 | 0.00 | 0.02 | 0.06 | 0.00 |
| | 29.2 | 5.2-5.9 | 0.12 | 0.17 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 |
| in front of wetfeeder | | | | | | | | | |
| (slatted floor) | 33.3 | 5.05 | 22.00 | 5.43 | 1.13 | 0.00 | 1.43 | 0.08 | 0.04 |
| in front of dryfeeder | | | | | | | | | |
| (slatted floor) | 37.0 | 6.27 | 2.00 | 4.33 | 0.87 | 0.11 | 0.53 | 0.02 | 0.08 |
| (slatted floor) | 56.0 | 6.69 | 5.12 | 6.63 | 1.01 | 0.07 | 0.75 | 0.19 | 0.06 |
| (solid floor) | 83.8 | 6.44 | 0.27 | 12.86 | 1.29 | 0.07 | 0.80 | 0.27 | 0.00 |
| (solid floor) | 44.6 | 5.86 | 15.79 | 15.08 | 1.81 | 0.10 | 0.73 | 0.30 | 0.00 |

| Location | $NH_3$-N, mg/g | $Cl^-$, mg/g | $SO_4^{2-}$, mg/g | $Mg^{2+}$, mg/g | $NO_3^-$, mg/g |
|---|---|---|---|---|---|
| in drinking bowl | | | | | |
| (+/- clear water) | 0.01 | 0.21 | 0.00 | 0.02 | 0.00 |
| (dirty water) | 3.23 | 2.133 | 1.56 | 0.05 | 0.00 |
| in wetfeeder | 0.09 | 0.52 | 0.49 | 0.71 | 0.00 |
| | 0.11 | 0.94 | 0.40 | 0.66 | 0.07 |
| in front of wetfeeder | | | | | |
| (slatted floor) | 1.60 | 0.87 | 0.67 | 1.20 | 0.00 |
| in front of dryfeeder | | | | | |
| (slatted floor) | 0.86 | 1.03 | 0.87 | 2.44 | 0.00 |
| (slatted floor) | 2.10 | 2.62 | 0.73 | 2.09 | 0.00 |
| (solid floor) | 2.71 | 3.29 | 2.70 | 5.22 | 0.00 |
| (solid floor) | 2.26 | 2.06 | 1.85 | 2.38 | 0.00 |

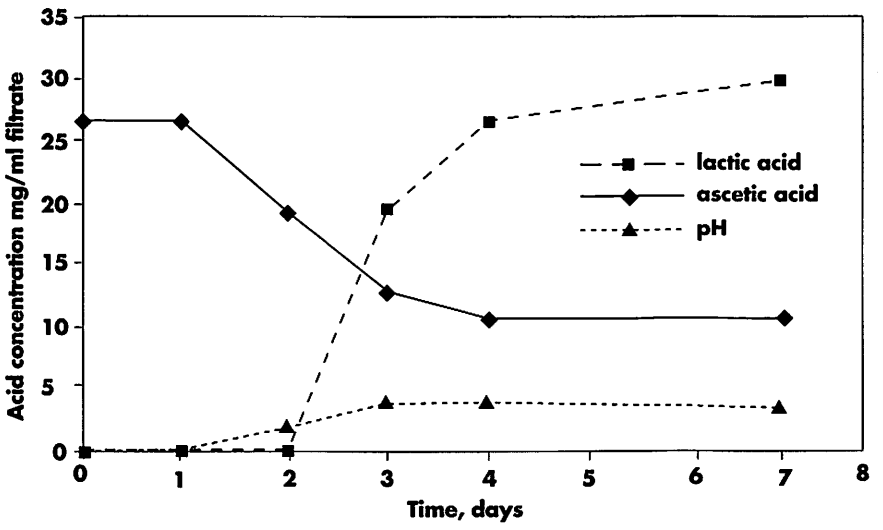


**Fig. 2 Average course of pH and concentrations of lactic and acetic acid in meal/water mixtures.**

with the concentration measured in a fresh meal/water mixture. In front of the troughs, the concentrations registered (4.3 to 15.1 mg/g fresh material) and were higher than in the first experiment (maximum 2.8 mg/g fresh material or 3.9 mg/ml liquid in one of the samples). Nilsson (1993) reported concentrations of 3.9 to 23 mg/g fresh sample in manure on floors in houses for fattening pigs. Hoeksma (1988) mentioned 3.2-11.0 mg/g fresh sample for pig slurry. It is therefore probable that most of the acetic acid stemmed from the manure. Nilsson (1993) also listed higher amounts of acetic acid for manure on solid floors (21-23 mg/g fresh sample) than for manure on slatted floors (3.9-4.4 mg/g fresh sample). This corresponds more or less with the results of the current investigations: 12.9 and 15.1 mg/g fresh sample on solid floors; 4.3, 5.4 and 6.6 mg/g fresh sample on slatted floors.

Propionic and butyric acid were found in concentrations up to 1.8 mg/g fresh sample and 1.4 mg/g fresh sample. Isobutyric, isovaleric and valeric acid were present in some samples, but always in concentrations below 0.3 mg/g. These concentrations are small compared to the concentrations of acetic acid, which appears to be the most important volatile fatty acid.

The contents of $NH_3$-N in the samples on the floor ranged from 0.9 to 2.7 mg/g fresh sample (1.1 to 3.5 mg $NH_4^+$/g), corresponding with the average of 2 mg/g fresh material in swine solid manure and slurry measured by Mårtensson (1991) and the 1.3-5.5 mg/g fresh material mentioned by Hoeksma (1988). The $NH_3$-N in the samples is therefore likely to have arisen from manure.

The concentrations of the aggressive ions in the fresh samples amounted to 3.3 mg $Cl^-$/g, 2.7 mg $SO_4^{2-}$/g and 5.2 mg $Mg^{2+}$/g. In one sample, $NO_3^-$ was found (0.07 mg/g). The samples from the wetfeeders and from the drinking bowls usually contained less $Cl^-$, $NH_4^+$, $SO_4^{2-}$ and $Mg^{2+}$, except for one drinking water sample that was probably quite contaminated with manure. The Dutch standard NEN 5996 (1988) establishes different levels of aggressiveness, depending on the pH and the concentrations of $Mg^{2+}$, $NH_4^+$ and $SO_4^{2-}$. Class 5 (aggressive) is divided into 5a, b, c and d (slightly, moderately, highly and very highly aggressive) (*Table 2*). According to this subdivision, the measured sulphate content of samples on the floor is in the moderately aggressive area, the magnesium content in the moderately to very highly aggressive, and the ammonium content in the very highly aggressive area. Svennerstedt (1989) observed in concrete floors in animal houses a chloride content ($CaCl_2$) of 0.3 to 1.3% of the cement mass. International recommendations limit the allowable chloride concentration in concrete to 0.4% of the cement mass.

Differences between the samples can be explained by the difference in dry matter content and sample composition (different proportions of manure and feed residues) e.g. the higher concentration of lactic acid in the sample taken in front of the wetfeeder and in the last sample taken in front of a dryfeeder could be explained by a higher amount of feed remnants in these samples.

## Conclusions

The presence of aggressive components in acidifying meal/water mixtures and manure on the floor in pig houses can result in severe concrete corrosion.

Lactic and acetic acid appear to be present in rather high concentrations up to 22 and 15 mg/g fresh sample. Taking into account the aggressiveness of these acids to concrete, they are very important factors in the process of concrete corrosion. The lactic acid originates from acidified meal/water mixtures, but the major amount of the acetic acid is likely to come from the manure. Other volatile fatty acids were registered in lower concentrations of maximum 1.8 and 1.4 mg/g fresh sample for propionic and butyric acid and below 0.3 mg/g fresh sample for the others. Aggressive ions could be detected in the fresh samples in concentrations up to 3.3 mg $Cl^-$/g, 2.7 mg $SO_4^{2-}$/g, 5.2 mg $Mg^{2+}$/g and 2.7 mg $NH_3$-N /g.

**Table 2 Aggressiveness of solutions to concrete (concentrations in mg/l).**

| Agressiveness class | pH | Ion concentration, mg/l | | |
|---|---|---|---|---|
| | | $NH_4^+$ | $Mg^{2+}$ | $SO_4^{2-}$ |
| 5a | >6.5 | 15 - 30 | 100 - 300 | 200 - 600 |
| 5b | 6.5 - 5.5 | 30 - 60 | 300 - 1500 | 600 - 3000 |
| 5c | 5.5 - 4.5 | 60 - 100 | 1500 - 3000 | 3000 - 6000 |
| 5d | 4.5 - 4.0 | >100 | >3000 | >6000 |

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# Acorns, caterpillars and ugly ducklings wanted

A £2.5 million national advertising campaign aimed at transforming, ambitious small firms into the country's future wealth creators was launched recently by Richard Page, Small Business Minister, together with the results of a national survey of fast-growth companies.

The survey by Business Links of 160 fast growing firms reveals that *'drive and ambition to achieve something worthwhile'* is the number one factor behind their success, while *'difficulties in sourcing finance - allied to cash flow problems'* is viewed as the main barrier to growth.

Small and medium sized firms who took part said that *'taking a customer focused approach'* was second most important factor behind success. This was followed by *'the quality of goods and services - seeing quality as a competitive edge'*.

When asked about the main obstacles they faced , *"the sheer lack of time to undertake strategic planning, due to constant fire fighting."* came in second, with the *" inability to find a workforce with the right skill"* as third.

## Factors behind success

1. Management's drive to achieve something worthwhile- **22%**
2. Customer focused approach- **21%**
3. Investment in quality, giving a competitive edge - **16%**
4. Flexible trained work force - **14%**
5. Innovation - constantly looking to adapt and improve management, products, services and processes - **14%**
6. Good strategic and financial information and planning - **13%**

## The barriers to growth

1. Inability to source adequate funding/ cash flow problems - **24%**
2. No time to plan due to constant firefighting - **19%**
3. Inability to find workforce with right skills - **16%**
4. Size and location of premises - **14%**
5. No time to update your own skills - **14%**
6. Fear of losing control as company size increases - **13%**

The results were published as Mr Page launched the first national Business Link advertising campaign. Three separate posters and press ads will feature pictures of a butterfly, swan, and oak tree to specifically target growth companies with the messages "caterpillars", "ugly ducklings" and "acorns" wanted.

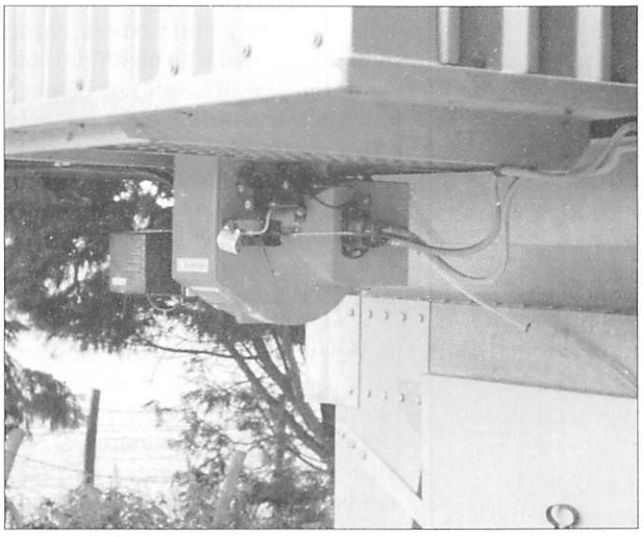
Launching the campaign, Mr Page said: " There is no 'miracle grow' solution to success. This survey shows that ambition and drive are key to growth because expansion involves a lot of effort, risk and very often increases the number of problems people have deal with. The most worrying finding is how difficult small firms find it to cope both with the day to day pressures of running a company and undertaking the planning necessary for growth.

" Business Links have been set up to offer professional, hard-headed, independent support to help smaller firms get on the road to and keep there. While Links help all firms improve their efficiency, it is vital that they reach more and more of the firms which have the ambition and commitment to grow. Quite simply, these businesses are our country's future. They will create our future trade, wealth and jobs and they need the right support to do this.

"There is no shortage of entrepreneurial spirit, we have the highest business start up rate in Europe but too few of these businesses go on to grow. So the central message of this national advertising campaign is that it doesn't matter whether you are big or small, its the size of your ambition that counts."

The advertising campaign begins as coverage for the national Business Link network reaches 96% of firms. Updated figures show that over 6500 businesses are using the network each week - 59% of these are firms with under 10 employees. Some of the firms which have used Business Link to achieve growth are featured in national and local radio adverts.

# Monoflame burners drying crops around the world



Monoflame Ltd supplies custom-built Ecoflam burners to Law-Denis Engineering Ltd, manufacturers of SCN Sureflow grain dryers which are in use around the world, drying a variety of crops including cereals, pulses and a number which yield vegetable oils. The heat generator is one of the grain dryer's major components and, in order to adapt Ecoflam oil-fired burners to suit Law-Denis's particular requirements, Monoflame carries out special modifications to models from the appropriately named MAJOR range.

Law-Denis demand a good deal of flexibility in heating capacity so that the dryers are suited to handling crops as diverse as wheat, barley, oats, peas, beans, linseed and oil seed rape. In addition, the dryers need to be capable of operating efficiently in a wide range of ambient conditions, as thirty percent of Law-Denis grain dryers are exported worldwide.

To accomplish this, Monoflame incorporates three stage capability in the burners, so that they are able to operate on low, medium and high settings to provide the dryer with low/medium and medium/high drying flexibility. In addition, the burners are supplied with hydraulic air actuators for simplicity of operation in an environment where airborne debris can affect more delicate electronic equipment. A weatherproof housing is provided to protect the electrical terminals from the elements and all controls are supplied separately for incorporation in a remote, fully automatic control panel.

Market leader in the field of crop drying and used by most of the co-operatives, grain merchants and maltsters, the SCN Sureflow range is constructed to a particularly high specification and is available in capacities from 6 tonnes/hour to 250 tonnes/hour. The MAJOR range of oil-fired burners is available in eleven sizes and to date, three of these have been supplied to Law-Denis : sizes 60, 80 and 120, with capacities of 400 kW to 1400 kW. Monoflame's range of Ecoflam burners employs the very latest in air/fuel technology. This ensures that they combine maximum efficiency in operation with the economical use of fuel whilst, at the same time, reducing environmental pollution to a minimum.

Monoflame has provided training courses in burner commissioning and maintenance for Law-Denis staff , in order to enhance their technical support programme for customers.

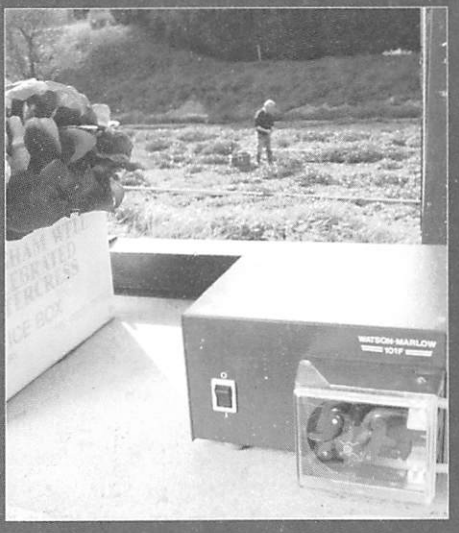
For further information, contact: **Mike Stone, Monoflame Ltd, 9 Goodwood Road, Keytec 7 Business Park, Wyre Road, Pershore, Worcs WR10 2JL. Tel: 01386 556092**

# Watson-Marlow pumps guarantee the pick of the crop

Prevention of a disease known as "crook root" in watercress requires a low dose of zinc sulphate monohydrate to be trickled into the watercress beds during the growing season from April to September.

On the advice of ADAS, Wingham Well Nursery, Kent obtained the perfect delivery system by purchasing a Watson-Marlow 101 F/R fixed speed low-flow single channel peristaltic pump to deliver 1.2 litres of zinc sulphate monohydrate over a 24 hour period during the blight season. The pump, which is situated in a shed for weather protection, delivers the fluid through 40 m of tubing to a borehole inlet at the head of the beds.

The result: no blight, no breakdowns and, most importantly, no lost



crops in the two years that the pump has been in operation. Even the original silicone pump tubing is still being used to deliver the chemical, which is dissolved in weak hydrochloric acid.

Further information from: **Heather Beale at Watson-Marlow Ltd, Falmouth, Cornwall TR11 4RU. Tel: 01326 370370.**

# Boughton mini-hook loader for Royal Botanic Gardens

The Royal Botanic Gardens, Kew has taken delivery of a Boughton demountable mini-hook loader system fitted to a single axle trailer with flotation tyres. The trailer is mounted behind a Massey Ferguson 362 and the trailer brakes are linked into the tractor hydraulic braking system. A separate handbrake lever is mounted on the nearside of the trailer unit.

The Boughton Hook Loader, Model 4/7.5-35, is driven from the tractor hydraulic system. The loader is activated by twin levers through the rear of the cab. It will be able to carry a payload, including the container, of some 3000 kg. The container dimensions are 3.5 m x 1.72 m x 0.9 m high giving a cubic capacity of 4.2 $m^3$ with an empty weight of 560 kg. The rear door of the container is of plywood construction.

Using the tractor hydraulics, the hook loader will demount a container in under 60 seconds and has the ability to tip up to 55 degrees. For complete safety in operation, the trailer has an automatic container locking system. The containers are used to carry waste, fertiliser and equipment around the gardens.

For further information, contact: **Rose Rauf-Colman, Reynolds Boughton Ltd, Bell Lane, Amersham, Bucks HP6 6PE. Tel: 01494 764411.**

# New mowers from Kverneland

**Two new mounted mower conditioners, with working widths ranging from 2.8 m to 3.2 m have been specially developed for high output mowing and conditioning in a compact and highly manoeuvrable format.**

**Kverneland has designed a new type of heavy duty steel rotor conditioner fitted with highly durable nylon tines, which will not damage following machinery in the unlikely event of breakage. The new conditioning system produces a swath with the crop's stems presented outwards for rapid wilting and easy feeding into forage harvester or baler pick-ups.**

**Kverneland has also launched four new mounted drum mowers, with working widths from the compact, rear mounted 2.1 m to the highest output, front mounted 2.7 m. All models feature oil immersed shaft and bevel gear transmission systems for reliability. Fast cutting height adjustment, quick release blades and contour-hugging adjustable suspension systems all help to enhance performance and ease routine maintenance procedures.**

**Contact:** Mark Brazier, Kverneland (UK) Ltd, Folly Rd, Roundway, Devizes, Wilts, SN10 2HP. Tel: 01380 722 361

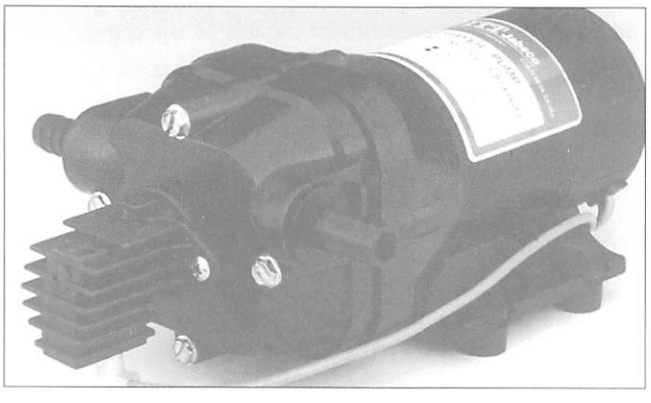
# New agricultural spot sprayer pump

Pump specialist ITT Jabsco has announced a new supply pump for herbicide and pesticide spraying applications. Designed specifically for use with motorised spot spraying or small boom spraying units, this pump is powered directly from the 12 V electrical system of the vehicle.

The model 30814-0012 features a four chamber diaphragm pump design, which gives a smooth flow of 5.7 litres per minute and extends pump life. Self priming to 3 m, the pump will operate at up to 5 bar. The pump offers excellent performance with a good spraying pattern throughout the pressure range.

The pump has been designed to provide performance with economy. A pressure switch eliminates the need for an expensive pressure relief valve and associated plumbing, whilst the low current draw motor extends the life of the vehicle battery.

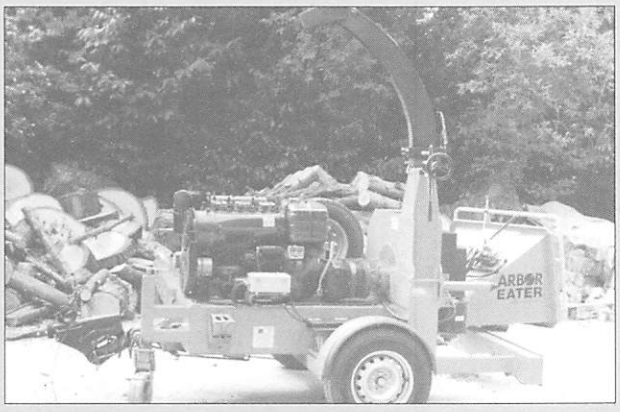
The pump body is made from rugged glass filled polypropylene and there are no unfinished metal covers, ensuring that the system is resistant to both the weather and any corrosive chemical spillage. Simple "snap-in" connectors are provided for the pump ports and just four screws need to be removed to disassemble the pump for extremely easy maintenance.



Enquiries to: **Chas Millard, ITT Jabsco, Bingley Road, Hoddesdon, Herts EN11 0BU. Tel: 01992 450145.**

# Arbor Eater Brushwood Chippers Ltd

The Arbor Eater Brushwood Chipper Model 200 combines a robust construction with ease of use, efficiency, and quality output. The 200 range is available with a choice of power options for maximum flexibility, including




tractor pto drive, 65 hp Lombardini diesel engine or 50 hp Hatz Quiet Pack which is an ideal option where minimum noise levels are important.

The pto version is fitted with 3-point linkage and wheels for non-road towing. The mobile versions are fitted with single axle chassis, brakes and full road lighting.

All chippers are fitted with twin hydraulic feed rollers which take material to the 3 bladed chipper wheel. Size of chip is important, and is quickly and easily adjusted to allow for individual output requirements. Blades, which are of high quality steel, can be sharpened easily, and replacement is simple and quick.

Built to very high standards, the Arbor Eater Brushwood Chipper 200 range has a large capacity of 200 mm which can handle brushwood, "lop and top" and thinnings. The specially designed discharge chute can be angled to place the chips either into a skip or directly on the ground in a defined area.

The Model 200 mobile chippers also available with twin axle carriage and slewing gear for added convenience and efficiency of use.

**TECHNICAL SPECIFICATION:**

| | |
|---|---|
| Chip length | 5 - 20 mm |
| Disc diameter | 780 mm |
| Disc thickness | 35 mm |
| Rotation speed | 1000 rpm |
| Number of blades | 3 |
| Max. roller opening | 200 mm |
| Production throughput | 14 - 18 $m^3/h$ |
| Feeding hopper size | 1.2 x 0.7 x 1.3 m |
| L x W x H | 3.5 x 1.8 x 2.6 m |

For further information, contact: **Michael Dalrymple, 1 Charlwood Place, Charlwood, Surrey RH6 OEB. Tel: 01293 862036**

# First Korean agricultural contract for VarityPerkins

VarityPerkins has announced that its new Perkins 900 Series has been selected by Korea's leading agricultural equipment manufacturer, Daedong Industrial Co. Ltd, to power the latest addition to its very popular tractor line. By the end of 1996, almost 1,200 Perkins 903.27 engines will have been supplied to Daedong for its D48 tractor.

The Perkins 900 Series range is a clean, direct injection, three cylinder, naturally aspirated diesel engine. The 2.7 litre engine rated at 50 bhp is 10 percent more powerful than its predecessor, uses 5 percent less fuel, is 50 percent quieter and is free of visible smoke. Its compact size makes it suitable for a wide variety of applications in mobile equipment and the Korean farming equipment needs clean and compact engines.

Jimmy Shen, Perkins Asia Pacific Vice-President, said: "This represents an important breakthrough for VarityPerkins in the highly competitive Korean market.

**Perkins 900 Series selected by Daedong Industrial Co for its D48 tractor.]**

Daedong Industrial is our first agricultural customer for the Perkins 900 Series and we look forward to a long partnership with them."

Founded in 1947, Daedong Industrial is Korea's largest and most experienced manufacturer of agricultural equipment with a national market share of 40 %. Leading-edge technology is applied to the design of tractors, power tillers, combine harvesters, rice planters, garden tillers, binders and small gasoline and diesel engines.

With assets of nearly $2 billion and annual sales of about $2.4 billion, Varity Corporation (NYSE:VAT) ranks among the largest US industrial companies. Its products include Perkins diesel engines, sold to more than 600 equipment manufacturers throughout the world; Kelsey-Hayes conventional and anti-lock braking systems for the automotive industry worldwide; DaytonWalther wheel and brake components for medium and heavy-duty trucks and trailers; and the Zecal process for bonding copper to ceramics in electronic circuitry.

VarityPerkins Peterborough PE1 5NA. Tel: 01733 67474.

# Drift-free process oxygen measurement made easy


Panametrics has designed a compact, on-line oxygen transmitter which enables process oxygen determination from 0.01 % to 100 % to be carried out as easy as temperature and pressure measurement. The new XMO2 analyser can be used where accurate and drift-free oxygen measurement is critical such as inerting/ blanketing, reactor feed gases, flare gas, catalyst regeneration, oxygen purity, sewage digester gas and many other applications.

Panametrics employs its thermoparamagnetic measurement technique in the XMO2 to overcome the limitations of conventional oxygen analysers. Oxygen's paramagnetic properties are used to create a 'magnetic wind' which is sensed by thermistor pairs. The transmitter's microprocessor determines oxygen concentration and background gas compensation.

Since the instrument contains no moving parts as in traditional dumb-bell type analysers, the XMO2 can be mounted in any position and is unaffected by vibration. It can also be placed at the process measurement point, minimising sample conditioning requirements and giving fastest possible response.

Panametrics has also replaced the hot filaments used in conventional magnetic wind type analysers with thermistors, eliminating a source of erroneous readings while improving stability and reliability. The dual-chamber cell design ensures insensitivity to contamination and flow variations and provides zero and span stability. The microprocessor compensates for variations in background gas composition and pressure while providing real-time error detection.

These design features give a linearity of better than 0.5 % of span, a long-term accuracy of 1 % of span, and a stability of 0.8 % of span per month. Recalibration may only be required two or three times a year. Measurement ranges are 0-1 % to 0-100 % as well as 90-100 % and 96-100 %. Special software enhances the response time of the sensor to less than 5 seconds for a 63 % step change.

The XMO2 transmitter requires a 24 V dc power supply and provides an isolated 4-2O mA output signal for oxygen concentration. The instrument is available in either weatherproof (NEMA-4X, IP65) with flameproof certification to EExdIICT6 pending.

The XMO2 can be programmed in the field or remotely with application-specific data via an RS232 interface and three-level, menu driven software. An infrared communications interface for programming in the field will become available during 1996, with hazardous area certification. Recalibration is accomplished quickly and easily through the software with no pots to adjust.

Panametrics offers a complete line of accessories including custom-designed sampling systems and loop-powered displays.

Further information from: **Arthur Berry, Panametrics Ltd, Unit Two Villiers Court, 40 Upper Mulgrave Rd, Cheam, Surrey SM2 7AJ. Tel: 0181-643 5150.**

## Laforge front hitches from John Deere

John Deere has been appointed sole supplier of the award-winning Laforge three-point front hitches for the company's tractors, covering all 6000, 7000 and 8000 Series models.

Laforge offers the most extensive range of hitches available on the market, to suit any application. All models are fully approved by John Deere as allied equipment.

Units for 7000 and 8000 Series tractors feature a patented electronic position and traction control, which first won a Silver Medal at the Paris SIMA Show in 1993, and an American AE 50 Award the same year.

The latest GreenLink 80i unit is the only three-point front hitch developed in collaboration with John Deere for 8000 Series tractors. It won a Gold Medal at SIMA in 1995, and has recently been awarded a further AE 50 Award as one of the 50 farm equipment innovations of the year in the USA.

This fully integrated unit incorporates an InterCoupler quick-attach frame for safe hook-up of front-mounted equipment, combined with the ability to follow ground contours fully. It has a maximum lift capacity of 5500 kg at the hook ends.

Optional electronic controls have been designed to utilise the tractor's own electronic control system, to achieve efficient position and traction control as well as weight transfer, for improved traction and steering response.

GreenLink units are the only hitch on the market that can integrate with the John Deere 8000 Series tractor electronics in this way, for automatic control of front-mounted implements in relation to wheelslip, without any interference to the rear draft control system.

Laforge hitches place no limitations on the tractor's steering angle, ground clearance or access for maintenance. GreenLink units are also compatible with John Deere's front pto systems and loaders.

Front-mounted equipment can offer a number of advantages over rear-mounting only. These include a reduction in tractor passes and easier, more efficient control of operations such as row-crop and field cultivations, mowing and topping.

For further details, contact: **Gordon Day, John Deere Ltd, Langar, Nottingham NG13 9HT. Tel: 01949 860491.**

# Launch of new Sauer-Sundstrand open circuit piston pump

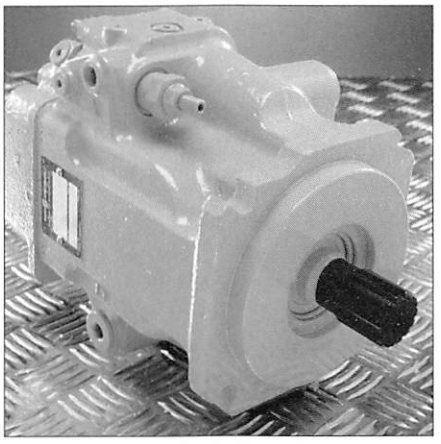
Hydraulic power equipment manufacturer Sauer-Sundstrand Ltd has launched a new open circuit axial pistol pump range, the Series 45. The units are specifically designed for universal use in mobile and stationary equipment, particularly in agricultural and construction applications. The first available frame size is 57 $cm^3$, with other frame sizes under development.

Offering high performance with a maximum operating pressure rate of 350 bar, long service life and enhanced reliability, the Series 45 family affords a preview of the future for advanced open circuit technology. Its design is compact and simple, with a fully integrated control system for direct, fast response. Parts are symmetrical and kept to a minimum ensuring easy and cost-effective installation and low total life operating costs.

The Series 45 provides 57 cc as a high flow option in the equivalent envelope of existing 45 cc pumps. The size of the unit is an important design feature: it is compact enough for future application demands to fit within the existing system envelope, allowing optimum product configuration for the transfer and control of hydraulic power. It is also equipped with high power auxiliary pads.

Design features unique to the Series 45 include a single end cap for both clockwise and anticlockwise rotations. Control spool and plug changes are necessary only for load sense to pressure compensated conversions; conversions to other options are integral to its design.

Performance and durability are aided by low shaft deflection and non-shimmed input shaft bearings which are robust enough to handle large external



loads. Reliability is also enhanced via its unique assembly method and the fact that no gasketed joints are utilised in the pump assembly.

Series 45 variable displacement pumps are high power density units, using the parallel axial/piston slipper concept in conjunction with a cradle swashplate to vary the pump displacement.

With its modular design, the Series 45 offers a broad range of controls and auxiliary drives. A built-in pressure compensator valve provides the control to vary the swashplate angle from its maximum displacement to the minimum zero flow position, when the set pressure is reached. Controls are also available for remote pressure compensators and load sensing systems. A displacement adjustment screw is available allowing the maximum flow to be adapted to match system requirements. These controls are designed for low hysteresis and responsive performance achieving maximum controllability in all modes of operation.

Series 45 can perform at a continuous operating pressure rate of 280 bar with its maximum pressure rating being 350 bar. Case pressure limit is 0.5 bar above inlet pressure and 2.0 bar maximum. Inlet pressure can be at a minimum of 0.5 absolute bar and at a continuous rate of 0.8 absolute bar. With speeds up to 2450 rpm, responses and recovery times are fast. It provides an infinitely variable flow rate between zero and maximum of 57 l/min per 1000 rpm.

For further information, contact: **Dave Eastwood, Sauer-Sundstrand Ltd, Cheney Manor, Swindon, Wilts SN2 2PZ. Tel: 01793 530101.**

# Tama commences netwrap production in the UK

Tama, the world's leading manufacturer of round bale netwrap, has started production at its new Nottingham factory. The factory will ensure the consistent supply of the high quality Tamanet - the UK's leading brand of netwrap - which was formerly manufactured in Israel.

The UK based production facility will enable Tama's sole agent, United Agricultural Twines (UAT), to respond rapidly to any seasonal changes in demand, and to provide distributors with varying volume requirements as and when needed. It will also ensure the company's researchers develop products which meet the exacting demands of the UK farmer.

Tamanet is renowned for producing consistently reliable results through all makes of round baler, enabling farmers and contractors to achieve optimum outputs. The UK factory will also manufacture Zebra net, a new striped net wrap to be launched by Tama this season to assist baler operators and farmers.

The asymmetrical stripes in Zebra net are broader on one side of the roll than the other, helping to ensure bale operators always insert the net the right way around first time. It also shows farmers who use a spin feeder to feed silage which way the bale will unroll.

The UK factory cost over £1 million to equip and utilises the most modern machinery available. It incorporates extensive quality control and testing procedures. It will also be a major distribution site for the full range of UAT products.

Tamanet is retailed across the UK by a network of agricultural machinery and farm supplies distributors. It forms part of UAT's market leading range of baler twine, round bale net wrap and stretch wrap.

For further information please contact: **Bart Cope, United Agricultural Twines, Old Searchlights, Runwick Lane, Farnham, Surrey GU10 5EF. Tel: 01252 727272.**

# JCB launches four wheel steer Fastrac

**JCB Landpower has introduced the world's first four wheel steer, fully suspended draught tractor - the JCB Fastrac Quadtronic. The machine is shown here in Proportional Tracking mode which provides the tightest turning circle available on the Quadtronic system.**

In 1991, JCB Landpower revolutionised the tractor market with the launch of the world's first high speed, high draught tractor, the JCB Fastrac. In 1996, the company is set to do so again as it introduces the world's first four wheel steer, fully suspended draught tractor, the JCB Fastrac Quadtronic.

Based on the smaller Fastrac 1115 and 1135, the new machine is available with 115 hp naturally aspirated and 135 hp turbo-charged Perkins 1000 series engines. Both machines will offer farmers unbeatable levels of manoeuvrability, in addition to retaining all the benefits of the existing models namely:

* four equal sized wheels
* full suspension
* four wheel braking
* centrally mounted
* equal weight distribution

The Quadtronic system, which has been developed by JCB Landpower at its factory in Cheadle, offers farmers the unique ability to adjust the machine's steering mode to suit all applications - from spraying to tight turning at headlands, from ploughing to farmyard and road duties - ensuring optimum performance on every operation undertaken.

Turning circle in four wheel steer mode is reduced by up to 30 % (depending on tyre size) compared with conventional steering, making the Fastrac Quadtronic best in class by a significant margin. Built-in safety measures ensure that the operator cannot drive in any four wheel steer mode where it would be unsafe. Upon reaching a speed of 20 km/h, the rear axle is safely engaged into two wheel steer mode. For fail-safe protection, a pneumatically operated mechanical lock secures the rear axle.

Whereas conventional tractors rely on two wheel steer, the Quadtronic four wheel system provides operators with five instantly selectable steering options, which are unique to an all-purpose tractor, ensuring that whatever the farm application, the Fastrac Quadtronic has the mode to match. As well as *two wheel steer*, the new machines offer *Proportional Tracking, True Tracking, Delay* and *Crab modes.*

*Proportional Tracking* allows fast, sharp turns. When this mode is utilised, the rear axles turn 1° for every 2° that the front axle turns. This ratio continues up to the maximum for each axle, (20° for the rear and 40° for the front) and gives the tightest turning circle available on the Fastrac Quadtronic system.

The *True Tracking mode* ensures that both the front and rear axles follow the same line for minimal ground marking and crop damage. The front and rear axles both turn to 20° (the rear axle maximum lock) allowing a tight turning circle of 12 metres.

The front wheels have the potential to turn a further 20°, taking the axles out of true tracking. An audible indicator sounds when the front wheels are turned past the 20° mark. Should the operator choose to ignore the indicator, he can gain a tighter turning circle but without both axles following the same line.

The *Delay mode* has two stages of operation, providing four wheel steer for headland turns but two wheel steer for field applications. The front wheels can be turned to approximately half lock with the rear wheels remaining straight. This ensures that the back end of the tractor and any trailer or mounted implement does not swing into a crop parallel to the Fastrac. Once half lock is exceeded, the rear axles automatically match the front, degree for degree, until maximum lock on both axles is achieved.

When activated, the *Crab Steer option* moves the front and rear axles in parallel in the same direction and allows the Fastrac to operate effectively in the most delicate of situations.

The JCB Fastrac 1115 and 1135 Quadtronics are fitted with a Headland Management System which ensures faster and easier turns at the headland for the operator. By activating the system, the driver can switch from two wheel steer to four wheel steer and, if selected, disengage the differential lock when the rear three point linkage is raised and conversely switch back when the linkage is lowered. Additionally, the system can be operated from an implements control box via the interface socket on the control panel.

To ensure the reliability of the new steering system, JCB has submitted it to an extensive period of testing. For easy maintenance a self-diagnostic computer monitors, all key components to ensure they are operating correctly.

The JCB Fastrac 1115 and 1135 Quadtronics offer operators exceptional working environments. The spacious, OECD tested cab is ROPS approved, comes equipped with a full sized passenger seat, an air conditioning system, easy to read instrument panel and provides exceptional all round visibility. As with the all machines in the Fastrac range, the new Quadtronics feature a mid-mounted cab, a rear deck, an all-steel 'Z' section welded ladder type chassis, JCB's unique suspension and twin line air trailer brakes.

For further information, contact: **J C Bamford Excavators Ltd, Rocester, Staffs ST14 5JP. Tel: 01889 590312.**

FMC

# Mechanical Engineer

FMC Agricultural Machinery Division based at Fakenham Norfolk, is seeking an experienced and creative mechanical design engineer qualified to degree standard and/or chartered engineer status, to work on existing and new products for the harvesting of vegetables.

Ideally, you should have a working knowledge of all design aspects of special purpose vehicles for agriculture or off road vehicle technology, including: hydrostatic drives and circuitry; vehicle steering, braking and dynamics; stress analysis (FEA) of welded structures; European CE requirements; European road regulations; design for assembly.

You should have 3-5 years experience and have shop floor credibility as well as being articulate and self motivated and able to present your projects for management review. The design team is small and the successful candidate will have ample scope for self expression and creativity.

**Applications in writing to:**
**Mrs Mary Osborne,**
**Human Resources Manager,**
**FMC Corporation (UK) Ltd,**
**Holt Road,**
**Fakenham,**
**Norfolk NR21 8JH**

**Closing date: 14 October 1996**



# Sultan Qaboos University - Sultanate of Oman

*College of Agriculture*

## FOOD CHEMIST

Sultan Qaboos University, the national university of Oman, invites applications for Food Chemist (assistant, associate or full professor), Department of Food Science and Nutrition, College of Agriculture.

The incumbent will undertake teaching and research in food chemistry or related subjects in food sciences. The successful candidate is expected to develop and improve the academic programme in a specialised area of food science and contribute to advanced courses, including student research projects, seminars, and other duties assigned by the Head of Department. The incumbent will supervise technicians and other support personnel; and collaborate with scientists in other departments of the University, government agencies and private sectors in the development of research appropriate for improving the food and agriculture in Oman.

Applicants should possess a PhD degree in food science or related fields from a reputable university. Evidence of sensitivity to cultural diversity and fluent in both spoken and written English are necessary. Excellent communicative skills and a strong sense of commitment and enthusiasm for food science and nutrition programming are essential. Candidates with at least two years experience in a similar appointment of a recognised and reputable academic institution, who have demonstrated a desire for professional growth are desirable.

Apart from a very attractive tax free salary, the University offers free furnished accommodation, annual leave with round trip air tickets, end of service gratuity and free medical treatment in Government Hospitals in the Sultanate.

Interested candidates are requested to submit a letter of application and full resumÈ, quoting our Ref: ADV/AGRI/04/96, to:
The Director, Personnel Affairs,
Sultan Qaboos University,
P.O. Box 0, Al hod,
Sultanate of Oman

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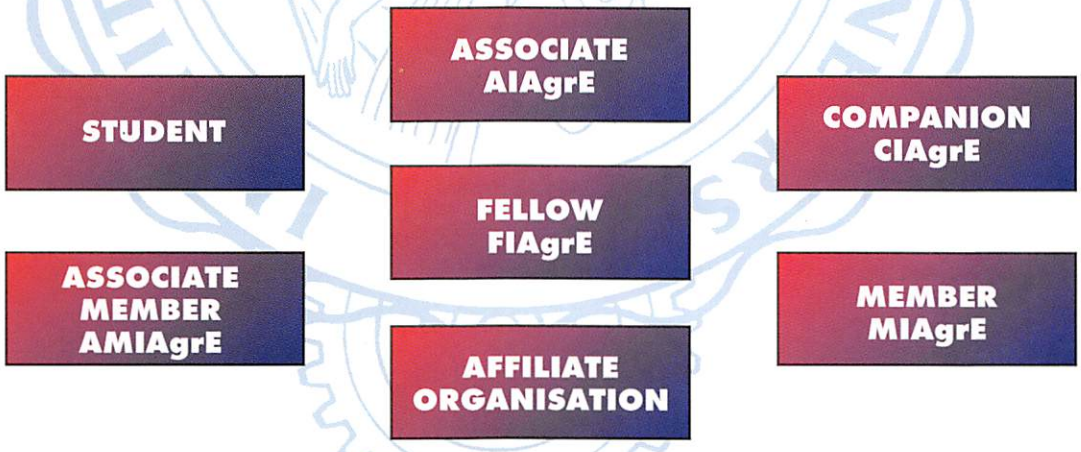


If you have found something of interest in this journal, you will surely fit one of these categories. Send for details of membership to:

**The Secretary, Institution of Agricultural Engineers, West End Road, Silsoe Bedford, MK45 4DU.**
**Tel: 01525 861096 Fax: 01525 861660**