Flexibility from servos

IN THE FIRST OF A NEW REGULAR SERIES ON COMPONENTS FOR PROCESSING AND PACKAGING MACHINERY, SIMON MARSDEN LOOKS AT THE BASICS OF SERVO DRIVE.

Mechanical drive systems perform well where designs can be specifically optimised to run one product. However, today's manufacturing environment requires increased responsiveness and versatility, particularly where packaging is concerned.

Servo drive systems are ideally suited to these challenges, coping well with changing demands. They are capable of high speed, high accuracy and, through synchronising actions and machines, will provide continuous motion. Being programmable they can be modified as required, leading to fast changeovers so that shorter batch runs are now cost effective.

More monitoring of the performance and health of the machine via feedback from the drives now also allows predictions to be made and potential failures caught early on. Additionally, during breakdowns, help screens can provide online assistance with fault diagnostics while all production data can be made instantly available both locally, to operators, and to management for planning.

One reason that servo drives are finding their way into an increasing range of machinery is that an expanding number of control systems suppliers, aggressively competing for a share of this growing market, has led to new systems being developed with an emphasis on ease of use at significantly reduced prices.

In turn, more machinery users have been drawn to consider how the technology will help improve their daily operations, particularly meeting the demands of the retail market for variety and lower prices while striving themselves for more brand awareness and shelf presence, for example by launching new products and innovative packaging.

For while production volumes may remain similar to those of previous years, the total is now spread over an increasing range of new flavours and varieties. The result is shorter runs and more changeovers, all of which take time and leave valuable resources idle.

This is where modern drive systems are providing some of the answers, carrying out the same machine operations, but in a much more flexible fashion than the typical mechanically controlled machine, with its main drive shaft and take-off points performing discrete operations such as the cam action of a sealing jaw or knife. Indeed, these take-off points may well include some form of gearing to ensure the correct speed ratio and that synchronisation is maintained.

Introducing inaccuracies

To cope with different products on the same machine, a range of settings and change parts, relevant to each product, are of course employed. The trouble is that these changeparts can take a long time to install and rely heavily on the skill of a technician or machine operator to set them up. This human intervention can introduce inaccuracies into the process.

So how do modern drive systems help? There are a number of different drive types and technologies available, from AC inverters, DC drives, servo and stepper drives, along with a range of hybrid technologies – each has its place, with the selection being made on either cost or performance grounds. However, servo drive technology is having the biggest impact in packaging applications.

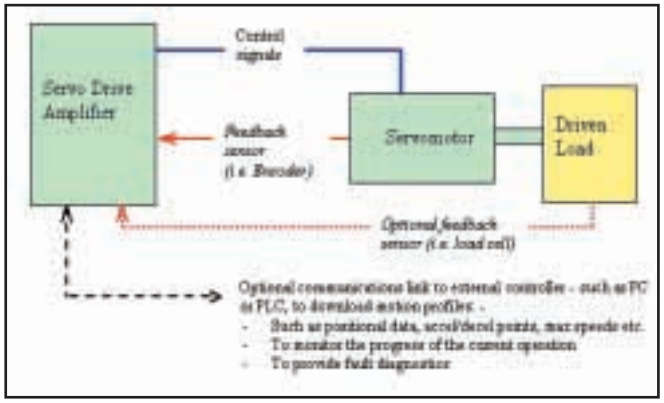
The basic configuration of a servo drive system consists of a servo motor to move the load, a servo drive that controls the motor and some form of feedback sensor to relay speed, position or torque data. These systems can operate in standalone mode or can be connected to an external control system, allowing complete motion control of multiple axes.

In a servo machine there is a main or master servo axis – which equates to the main drive shaft in a mechanical system – and any further servo axes, called "slaves", are referenced to this master axis in software, which equates to a take-off point in a mechanical system.

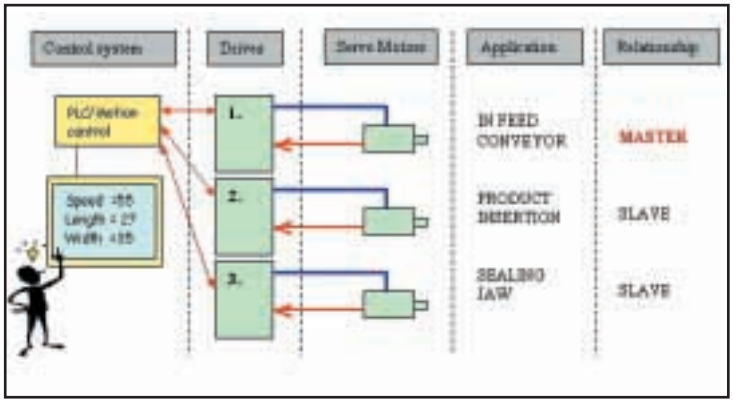
These servo drive systems are sophisticated and simulate mechanical actions such as gear ratios, a cam-box, or lead screw, but because these functions are software controlled they can be programmed to accept new parameters.

To highlight the benefits of servo verses mechanically controlled machines, consider the basic functions of a generic horizontal form-fill-seal machine.

In a mechanically driven machine there will be a main drive – perhaps controlling the speed of the infeed conveyor – with further auxiliary actions linked to the main drive – perhaps forming and placing the product into the pouch,



Typical servo system layout



Typical configuration of a servo controlled form-fill-seal machine

followed by controlling the heat-sealing jaws and so forth. These auxiliary actions are directly referenced in some way – through gearboxes or cam-boxes for example – to the speed of the infeed conveyor, so any change of speed is then correctly seen across the entire machine.

However, the important difference of the servo control machine is that master and slave axis are linked by software. The master axis is continually reading actual machine conditions: the positions and loads given by feedback data. All further slave axes then perform as directed in the control software, which for example, might describe a gear ratio or physical dimensions.

To change the machine over to a new product, the operator simply loads the control system memory with all the new data, which could include numerous variables such as ratios, speeds, and product dimensions. This set-up data may be selected from a number of pre-stored recipes made available through an operator touch screen. Therefore changeovers can be achieved at the touch of a button, downtime is kept to a minimum and productivity is improved.

Another area to consider is machine throughput rates. In a mechanically controlled machine, where numerous actions are linked to a main drive shaft, it becomes difficult to change the individual speeds of these actions in isolation without affecting the rest of the machine or process.

For example, in an application using gravity filling there may be a need for a slightly longer filling cycle, perhaps due to variations in consistency of the liquid or powder. This would generally mean slowing the whole machine down to achieve this new fill cycle time.

If a servo-controlled machine is to face the same problem, it is possible to design a control system to automatically compensate – within certain constraints – for variations in speeds of these individual actions.

Control system will compensate

Using the liquid/powder filling example above, if the operator wanted to add, say, 2 seconds to the fill cycle, the control system would compensate for this elsewhere in the machine. Indeed, the 2 seconds could well be made up through a combination of speeding up non-productive return cycles, reducing acceleration times or increasing running speeds elsewhere.

There are many other examples where servo drives are benefiting the operation and control of packaging machines. Some examples include:

- End-of-line machinery needs to be increasing versatile to cope with ever changing packaging, therefore case erecting, loading and sealing operations are being automated.
- The trend in volumetric filling is to upgrade filling speeds using smaller sized machines. This is being achieved by using servo drives.
- Servo adjusted liquid fillers will speed up changeovers. Additionally, servo operated pistons will ease cleaning.
- Carton erecting machines have been slower to move to servo controls. However, being able to cope with varying carton sizes is seen as a key advantage, so clearly the benefits of servos means their conversion is likely to grow.
- Pressure-sensitive labelling has been a major growth area with most labelling machinery manufacturers preferring a servo drive to the more traditional brake/clutch solutions. Manufacturers of sleeving machines are following closely behind.
- Wrapping machines tend to use servos at the higher quality end of the market, but as competition in the servo market forces prices down they are becoming increasingly relevant to general purpose, lower cost wrapping machines. ■