



## **Accuracy**

A good place to start a discussion about accuracy is probably to determine how much accuracy is required for the process and then look at ways it can be achieved.

A number of years ago, a 7 motor Synphase system was installed on a 10 section triple Narrow Neck Press & Blow IS machine running 172 cuts per minute. In an experiment during production, the induction motor running a Maul mechanical gob distributor was deliberately differentiated out of position to determine accuracy requirements. A 0.070 second movement brought the scoop alignment close to the edge of its window for proper load. It was felt that a 0.090 second movement would have cause the gob to string instead of load the trough. The gob distributor had a 3.488 second cycle time. The 0.070-second interval is 2.1% of the 3.488 seconds cycle time.

The Synphase control has been programmed for a 0.010 second deadband and variations of 0.012 seconds were measured. Pack was 98% or better for days.

Controlling the process at 5-10 times better than required is standard practice. An accuracy of 0.2% should be sufficient.

No chain is stronger than its weakest link. Likewise no drive system is more accurate than its least accurate part.

Applying this axiom to a drive on an IS machine mechanism forces us to look at the mechanical connection between the motor and the final driven part (shear blade, scoop, mold, etc.) Gearboxes, timing pulleys, couplings are all commercial grade components. None of them are selected as special, high accuracy, anti-backlash parts. Most machining tolerances are within 0.005 inch (0.13 mm). A gear tooth misplaced on a 5-inch diameter gear by .005 inch is 0.03% out of position. As more than one part is used in the total drive train, it is safe to conclude that the mechanical connection on average cause at least .1% variation from theoretical instantaneous positions. This is close to the measured requirement of 0.2%, but is still acceptable.

A Permanent Magnet Synchronous motor's rotor will lag 90 degrees behind electrical phase at full load and will lead 90 degrees ahead of electrical phase at full overhaul. In the experiment above, the inverter would have been supplying 71 Hz. A half cycle of 71 Hz is approximately 0.007 seconds or 0.7% out of position. Again, the accuracy is fine for the process.

Induction motors are the workhorses of industry. They are inexpensive, readily available, and familiar. A Synphase controller attached to an induction motor will maintain approximately 1 times (at high speed) to 3 times (at low speed) better accuracy than its uncontrolled P.M. Synchronous counterpart. This is better than required by the process.

In summary, because of the combination of low price and local replacement supply, TCD Systems recommends an inverter driving an induction motor if your IS machine will not exceed 550 bottles per minute.

However, if you are still not convinced, the Synphase system can be supplied with synchronous motors.