

# Plastics in Packaging



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## POP BACK

***Why the steel  
twist-off closure  
is making a comeback***



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**H**aving started life as a co-extrusion die maker to customers who could not afford the top-end Windmöller & Hölscher or Reifenhäuser blown film lines, 15-year-old Canadian firm Dual Spiral Systems (DSS) has established a solid niche in the market so much that one customer refers to its DSS die as its 'Cadillac'.

A luxury vehicle famous for its precision manufacturing, that stands it ahead of the competition, DSS would appear to have a lot to aspire to. DSS president Rafael Castillo explained the benefits that its 'Cadillac' brings to the customer during a meeting at the company's Mississauga, Ontario headquarters: "With our die, that customer was able to substantially lower its gauge deviation from six to below two per cent, achieve 2 sigma without a thickness correction device, increase output rates, and produce a better quality film. In addition, polymer savings pay for the die in just a year."

DSS has made a solid business out of manufacturing modular coex dies, which divide polymer flow from the extruder into two separate layers and therefore double the number of layers in a die. For example, a seven-extruder die would produce 14-layer film. This, says DSS, increases the number of interfaces between film layers and results in increased output rates, film strength and barrier properties.

"Twelve years ago people still used monolayer film," commented Castillo. "Now it's moving from three layers to five or seven, with the addition of cheaper fillers. Eleven layers is seen as a niche market now just as seven layers was years ago."

Blown film, explains Castillo, gives converters better dart properties than cast film and this is helped by the doubling of layers using a coex die. He adds that the cost of a cast line is also more prohibitive.

The objective of DSS is to sell to other OEMs who are focused on the whole blown film line. Here, the company's niche focus and expertise will provide a boon for the OEM.

"If a converter is producing three or five layers and gets an order for seven layers, then they need to source a die. But with the DSS die, the converter is able to reconfigure its existing five module die to process seven layers without having to add an additional two modules. Although it takes 8-12 weeks to produce a die, it takes 15 years to develop and perfect high-performance die technology. By selling our die to other OEMs we have allowed them to skip this lengthy development phase."

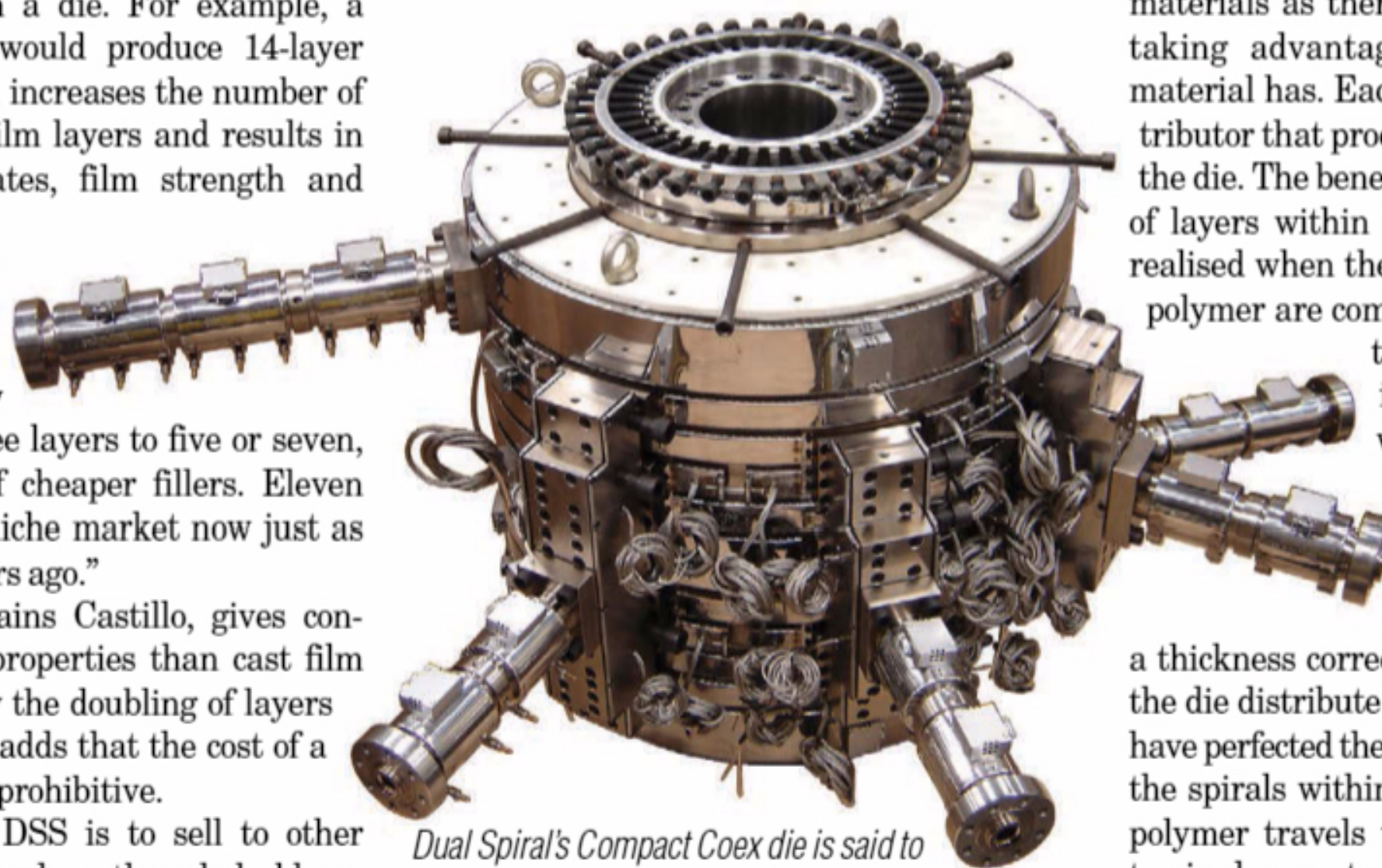
In the relatively slow moving blown film business, DSS has tried hard to push technology forward. With 60 of its traditional style coex

# Die another day

Co-extrusion has opened the door for film processors to incorporate resins that otherwise would not have been possible in blown film. **Steven Pacitti** visits a die manufacturer with a compact solution to the engineering challenge

dies on the market, which Castillo says adds capacity for the converter, DSS has already sold five of its new Compact Coex die, which was launched earlier this year.

"A higher number of layers is being requested so with a flow melt splitter you could have an 11 extruder die producing 22 layers. The die would get tall as you stack modules or layers one on top of another. A traditional 22-layer die would weigh 7,400kg. This is where the Compact Coex die comes in, not least because its total weight for a 22-layer compact die is around 3,865kg," he adds.



*Dual Spiral's Compact Coex die is said to reduce energy consumption by 60 per cent*

In the compact series, the die has been reduced in height and weight by 50 per cent compared to the traditional multilayer modular die system.

"What this die provides is lower residence time in the die due to shorter flow passages, faster purge and material changeover times as a result of lower residence time, 60 per cent less energy consumption due to reduced heat requirement, 50 per cent lower die weight, which simplifies die handling and moving the die, and 50 per cent lower die height, which allows for a lower blown film tower height, and increases output rates and cooling capacity."

Alongside the streamlined melt port entries, the die is also said to provide greater flexibility in running different resins. By splitting layers, better distribution is ensured and gases find it harder to travel through layers of film, hence providing enhanced barrier properties.

"Coextrusion allows you to use better or different barrier materials in the structure, whereas micro-layer dies are restrictive when it comes to material choice and production rate and are limited to processing only a select few different materials.

"DSS dies can process as many different materials as there are layers within the die, taking advantage of the properties each material has. Each layer is a unique flow distributor that processes a discrete layer within the die. The benefits of increasing the number of layers within the coex structure are only realised when the properties of each different polymer are combined within the coex structure. It is not enough to merely increase the number of layers within the die," explains Castillo. "We can achieve thickness variation of around two per cent 2 sigma, without the need for a thickness correction device. The modules in the die distribute polymer very accurately. We have perfected the polymer distribution through the spirals within the modules, which is how polymer travels through the die, using customised computer simulation software to chart an optimised flow leakage curve.

"To design the die, numerical simulations are employed to calculate how much polymer flows within the spiral grooves as opposed to flowing over the lands dividing the spiral grooves. This generates a flow leakage curve that determines, among other things, the flow distribution out of the module. As a result, moving polymer correctly at the appropriate shear rates distributes the polymer melt more accurately.

"An extrusion die should also be auto-cleaning and fast purging, allowing processors to switch from one material to another in under 10 minutes, with no hang-up areas where materials can stagnate and degrade.



The polymer flow path should be streamlined to ensure the melt experiences the most direct path from die entry to exit. This precludes 90 deg turns in the melt flow path employed in some designs. With a properly designed die, you can run it for five years without cleaning and not always with the same resin. A typical die of ours can provide a 20-to-30 year lifespan."

On the subject of different resins, the OEM will often test DSS dies using different materials. DSS focuses mainly on the extrusion system hot section, which includes dies, air rings, extruders and hoppers.

"We aim to push out the Compact Coex die and my sales target is 20-to-25 in the first year. Customers want more 11-layer films now for increased shelf life, dies capable of production rates above 2kg/hr/mm die diameter and nanocomposites will also grow in popularity as they start to become more commercialised."

The flexibility of co-extrusion dies is obvious when investigating the converter using them. A good example is a Russian film processor using DSS technology, which in 2010 installed the first 10-layer die in Russia and runs 220 different film recipes on the same die.

A typical 10-layer 200-micron film structure might include nylon, tie / PE / tie, nylon /

EVOH / nylon, tie/PE, and PE+antifog. For example, EMS Pa 6,66 (12-micron) on the outside, DuPont tie layers (16-micron each) sandwiched either side of ExxonMobil mLLDPE (24-micron), UBE Pa 6,66 layers (12-micron each) either side of EVAL EVOH (12-micron), a DuPont Bynel tie layer (12-micron) with ExxonMobil LDPE (60-micron), and an Exxon-Mobil mLLDPE (24-micron) on the inside.

"Resin firms can indicate trends in the sector and we have sold some dies to resin companies for research and development purposes. The market itself is cyclical and we probably have six or seven dies being worked on at any one time," said Castillo.

To replace a traditional die with a Compact Coex, Castillo explains that the height of the extruder would need to be changed. However, the die's weight savings mean that the customer is able to heat up the die quicker and use 60 per cent less energy in doing so, he adds.

The packaging sector represents more than 90 per cent of DSS business – pipe dies are also growing in significance as the business moves to co-extrusion – while most dies are sold into Europe, with some in the Middle East and Africa.

"The US is our major focus now and we've

approached a few OEMs there. We market our dies extensively to other machinery manufacturers who incorporate our die into their extrusion line."

Only a few OEMs specialise in their own dies, such as Macchi and Windmüller & Hölscher.

In its Ontario facility, DSS operates a number of 5-axis CNC machines, lathes manufactured by DUMA and Mori Seiki, and a surface grinder from Sundstrand.

"We used to outsource surface grinding but now we only outsource gun drilling," said Castillo, adding that 12 people work in the factory. "A bigger lathe is our target."

In a world where energy savings continue to be a focal point for all industries, film processors are faced with the challenge of producing materials economically with all of the required properties. Material compatibility is critical when it comes to film co-extrusion.

Combine the material side with a compact die and you have what would appear to be a good basis for ramping up multilayer film production.

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## Demag in packaging area

High efficiency

High return

Low cost

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