Is down gauging the only way to reduce costs?

The canmaking industry is increasingly called upon to reduce the production costs of cans. Reduced material consumption plays the most important part when reducing the production costs of 3-piece cans. To date, linear sheet gauge reduction has proved to be the best solution. It reduces not just the material consumption, but licence fees for the "Grüner Punkt" (a green recycling symbol used on packaging materials in Germany) or other recycling systems as well. The weight to be transported by the consumer is reduced, too.

Sheet gauge reduction has made rapid progress in recent years. The potential for sheet gauge reduction in can bodies has been exhausted to a large extent whereas there still seems to be a slightly higher potential as regards the sheet gauge of top and bottom ends.

A typical problem of such cans made from very thin material is their changed reaction to mechanical stress:

- Axial and panelling resistance decreases continuously:
  Decreases in axial resistance at the neck can be compensated - at least partially - by re-forming the shoulder of the neck.

- In the case of beading the interdependence of axial and panelling resistance is particulary obvious. Here, improvements can be achieved by using material with a higher resistance, more complex beading units and FEM-optimised bead geometries.

- There is a significantly higher risk of damage to the cans (dents) during conveying, both at the canmaker's and at the canner's plant.

- The risk of failure in the canner's autoclave increases considerably. To date, more complex counterpressure autoclaves can only be used in rare cases.

Further sheet gauge reductions as a means to reduce costs demand progress with regard to material strength and processing properties. Sheet gauge reductions generally result in the use of harder and, consequently, more difficult to form packaging material. Machines and forming processes with improved properties are required to an increasing extent nowadays in order to produce cans of the same or better quality.

The following describes an alternative way to achieve appreciable material reductions without falling below critical limits where the sheet gauge is concerned.

It aims at reducing the surface of the can (= material area) while maintaining the same volume. As everybody knows, the hollow body with the smallest possible surface for a specific volume is a sphere. This physical optimum is neither feasible nor desirable in the case of cans. It would, however, already be a significant progress if the mostly cylindrical cans came at least a little bit closer to a spherical geometry.

In practice this means that - as in the case of beverage cans - the diameters of the can bodies must be drastically reduced at least at one end so that smaller tops/bottoms can be seamed on.

This method has a triple effect on savings:

1. The blank diameter of the ends is reduced appreciably: material savings.

2. The total load exerted on the ends is reduced due to its smaller surface. As a result, the ends can be made from thinner material: down gauging without loss of resistance.

3. Due to the lower forces exerted on the ends the seam dimension can be slightly smaller: additional blank diameter reduction.

The necking process required for these savings is described below, followed by an example for its savings potential.

Spin-flow necking

The spin-flow necking process, which devolved from the 2-piece canmaking industry in principle, has been developed by Cantec GmbH & Co. KG into a patented version specifically designed for the production of 3-piece cans. This spin-flow necking process has an adjustable degree of forming per rotation to adapt it to specific material properties and combines a maximum diameter reduction with an attractive neck geometry (smooth neck) for SR and - especially important - for DR material. Can diameters can thus be reduced by up to 13 mm.

Spin-flow necker

A modified flow pressing process forms the neck between two inner tooling components, which rotate together with the can body, and an outer shaping roller. The number of shaping rotations depends on diameter reduction and material. It can be adjusted at infinitely variable increments up to a nominal rotary speed of up to 25 rotations per can. Specially developed high-precision clamping tools ensure that the can body securely follows these rotations. Upper and lower tool are centred relative to each other during the necking process so that radial forces can be transmitted without deformation. An accurately concentric neck geometry achieved without time-consuming adjustments is the result.

Spin-flow necking process

Cans with spin-flow necks

Example calculation

A 3-piece can with a nominal diameter of 83 mm is an excellent example to demonstrate the savings potential of this technology.
The calculation is based on the assumption that the can body remains totally unchanged (interior diameter, height, sheet gauge, lacquering, side coating). The slight loss of volume in the headspace caused be the neck is compensated the fact that spin-flow necking increases the height of the can by 1.0 – 1.5 mm.
Savings are solely due to the smaller ends.
In our example the welded can body is necked from 83.4 mm to 72.9 mm, which equals a diameter reduction of 10.5 mm.
Savings with regard to the ends are due to a smaller nominal diameter (step 1), a smaller seam (step 2) and the reduced sheet gauge of the end (step 3).

Step	Nominal end diameter	Sheet gauge	Blank diameter	Material consumption	Savings
	End for dia. 83.4 mm Seam: Sefel, type II	0.20 mm	99.2 mm	100 %	
1	End for dia. 72.9 mm Seam: Sefel, type II	0.20 mm	88.2 mm	79.0 %	21.0 %
2	End for dia. 72.9 mm Seam: Sefel, type OII	0.20 mm	86.6 mm	76.2 %	23.8 %
3	End for dia. 72.9 mm Seam: Sefel, type OII	0.18 mm	86.6 mm	68.6 %	31.4 %

The actual savings with regard to the ends will differ slightly from case to case because both the initial situation as well as the type (EOE, standard) and dimensions of end and seam will be different. But even in the worst case savings of 20 - 25 % should always be possible for the ends.

Apart from such direct savings, other savings are due to a higher degree of sheet utilisation if a higher number of blanks can be stamped out of sheets with the same dimensions.

If the cans are to be stackable, the other end of their bodies must be necked, too, and closed with a bottom with the corresponding diameter. This results in additional savings potentials.

The shaping of the can described above modifies its look. Although this may be desirable for marketing reasons, it must be coordinated with the canner whose canning and seaming equipment must be able to process different diameters, too.

The possibilities offered by linear sheet gauge reduction without can geometry modification have been exhausted to a large extent and only minor progress can be expected in the future. The ratio of savings to increased risk is becoming more and more unfavourable. Major material savings can only be achieved by modifying the can geometry.