Extrusion – A major change in focus

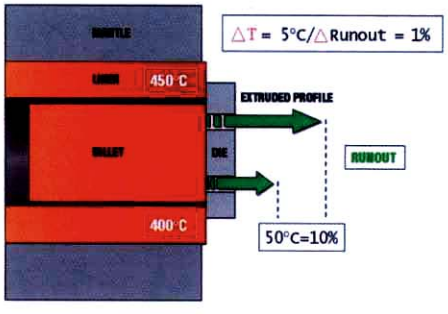
*By P Robbins**

An extruder basically doubles the real value of the alloy he is using, by changing its shape from a basic log to a useful and often complex and convoluted profile.

Nearly all of this added value is created at the moment the alloy passes through the die. The die therefore is, and always will be, the heart of the extrusion process. It is by far the main focus of attention by most extruders. This is understandable, because the die most extruders receive from their diemaker is usually just an approximation of what he really needs. The diemaker says, in effect, "This die should produce a profile that is very close to your drawing. Tell me the changes your die corrector had to make, and repeat dies should work from the first push."

Repeat dies don't always make good product from the first push, but that is usually not the fault of the design of the die. However, the fact that the extruder usually has to correct each new die at his own expense before it will work properly, is an anomaly that has been tolerated for too long by the light-metal extrusion industry.

By using numerical methods such as CAD, CAM, and FEM modelling, many diemakers can now provide dies that will make perfect product from the first push to the last, every time. But only if the alloy enters the die at a tapered optimum temperature, at a uniform velocity, and the die has been properly preheated.



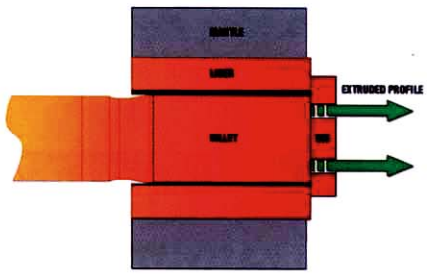
The results of non-uniform liner temperature

Unfortunately, the die maker must provide a die that is best suited for its anticipated actual use. If he knows that his die unlikely to be uniform at operating temperature before the first push, he must make it strong enough to withstand the resulting high breakthrough pressure. Press speed can then never be maximized. "A strong die is a slow die." If the die maker knows that the die will be properly preheated, the breakthrough pressure may often be reduced by as much as 30-40%. A lower breakthrough pressure allows a cooler billet temperature and greater press speed.

The focus of the extruder is now on making his production process more efficient.

First of all, absolute alignment, thermal as well as physical, is essential. The press itself should, of course, be in precise physical alignment, and the die mounted exactly in the centre of the container. The temperature of the container liner should remain uniform, bottom to top, to preserve the uniformity of the temperature of the alloy, and therefore the consistency of its flow from the container into the die.

Consider the ability and efficiency of the tooling and equipment available to today's extruder to assist him in producing a high quality product at a competitive price.



The ideal thermal alignement of mantle and liner

The billet can be taper-heated quickly by induction heaters or more economically by first bringing it to a base temperature with gas heaters, and then taper-heating by induction. Despite claims to the contrary, the billet cannot be effectively taper-heated by controlling the temperature of the container liner.

By using a container with both thermal sensors and heaters contained in a sub-liner between the container liner and mantle, and at least four zones, top bottom as well as axial, being closely monitored, the temperature of the billet can now be maintained within extremely close limits.

Even when the alloy enters the die uniformly at the ideal temperature and velocity throughout the push, the best die ever made may still not produce an acceptable section immediately if it has not been properly preheated. Then, a perfect profile is usually impossible, until one or two billets are wasted in heating the die.

The answer to this problem is the single-cell die oven which will bring the die quickly and uniformly to operating temperature. To avoid the initial capital expense of a complete battery of single-cell ovens, dies may be held at a moderate temperature for some time in a traditional chest oven, then the necessary heating completed in a single- cell oven when the die is needed.

An extruder today should be able to assume that his die will produce good product immediately, and concentrate on optimising his production process.

Castool single-cell die oven

For most extruders, the person best qualified to be responsible for process optimisation is his die corrector. He should be aware of the impact that every part of the production process has on the entire system. The target is 100% quality, minimum scrap, maximum speed, and minimum unscheduled downtime. The key to extrusion is the die. The key to profitable extrusion is the production system.

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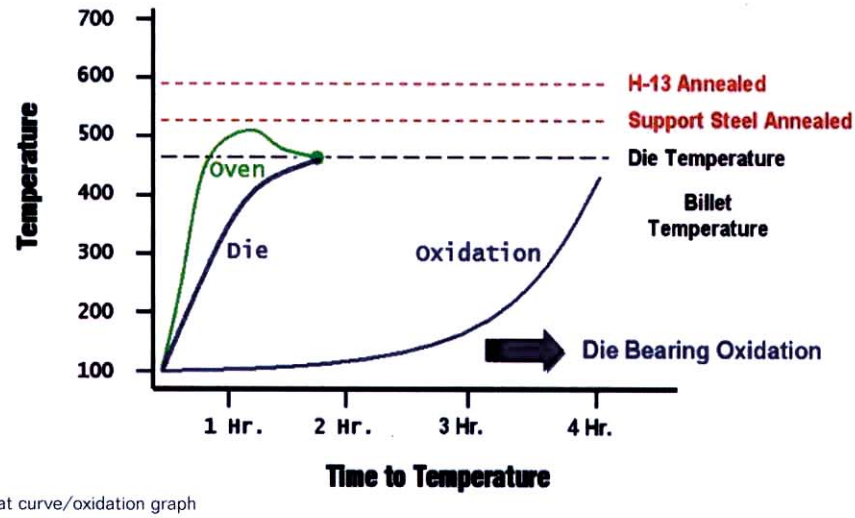

Heat curve/oxidation graph

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