Alternatives for Extruder Barrel Construction

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Today there are many options for barrel construction available to the extruder user. The choice of materials may be determined by the need for corrosion and/or wear protection, budget, ease of repair, or a combination of all of the above. This note is meant to briefly cover the primary options available today and is not meant to be an all encompassing report.

BASIC
Barrels can be fabricated from a solid piece of metal. The most common material is carbon steel with a nitrided interior. Nitriding gives a very thin hardened layer of only about .3mm, which results in a limited lifespan especially when processing abrasive fillers. For large extruders repair can be achieved by inlaying weld material. Smaller machines can be repaired by machining out the opening diameter and inserting a liner.

Solid barrels can also be fabricated from stainless steel with a hardened interior. However, the hardening process often lessens the corrosion protection aspects of stainless steel. Other negative aspects to solid stainless barrels are poorer heat transfer and cost. Therefore, this is usually an option for smaller extruders of certainly less than 50mm.

Bimetallic castings can also be applied to the interior surfaces in place of hardening the base metal. This can result in superior wear and/or corrosion protection but at a higher cost.

LINERS
For situations where ease of repair or high performance alloys are a consideration, lined barrels are typically chosen. The liners are thin walled and inserted into an opening in the larger load bearing barrel. Liners can be made from various hardened carbon steel, stainless steel, nickel based alloys etc.. any of which may also be used with a bimetallic coating.

Twin bore bimetallic liners can be fabricated either by HIPing (Hot Isostatic Pressing) a one piece figure eight insert or by cutting and welding individually spun tubes.

For lined barrels heat transfer can suffer somewhat because of the air gap between the liner O.D. and barrel I.D. in addition to the extra heat conduction resistance provided by the overall thicker barrel. This is especially critical when jackets are used instead of coring.

BIMETALLIC COATINGS
Bimetallic coatings are used when wear or corrosion are areas of concern. These coatings can be applied by traditional welding techniques in the case for large diameter barrels which are short. Centrifugal casting is the most common method used for both single and twin bore barrels. For the latter, this is a much more complicated fabrication technique as two separately spun tubes must be cut and welded to form the figure eight.

Holding dimensional tolerances during this welding operation is difficult and crucial to obtaining a good end barrel. As previously mentioned, HIPing is becoming more common for twin bore barrels as exposure of the base metal at the apex is eliminated. This is of particular concern when highly corrosive materials such as PVC or fluoropolymers are processed. Other advantages to HIPing are 1) the use of less expensive base metals, 2) lower porosity of the protective coating and 3) less dilution of the coating by the base metal.

There is a wide variety of bimetallic coatings currently available. The following table summarizes the basic types available with appropriate comments.

Overall Comparison of Bimetallic Coatings

Base Element Other Elements Rockwell C Comments

Iron Ni, Si, B, Cr, Ni 50-65 excellent wear resistance no corrosion protection

Nickel/cobalt Cr, Si, B, Fe <1 45-60 good wear resistance best for corrosion protection

Nickel/chromium W, B, Fe, Si 60-65 best wear resistance best for highly filled materials

very good corrosion protection

The choice of the coating that should be specified depends on the application. For noncorrosive processes with low to moderate amounts of fillers (up to about 30-40%) the iron based alloy is a good choice. Highly corrosive processes that involve HCl, PVC, fouropolymers, etc. can benefit from the Ni/Co family of alloys. These alloys will not only extend the life of the barrel but will also result in improved product quality that has little or no iron contamination from the extrusion process. Processes compounding high levels of abrasive fillers should use the third family of alloys with tungsten.

Use of the proper bimetallic coating can increase the lifespan of the barrel not only because of improved wear properties but also because the coating thickness can range from 1 .5 to 3mm versus the typical nitrided layer thickness of .3mm.

In summary, there is a wide variety of options currently available. The choice depends largely on the processing application for which the extruder is intended. Use of the appropriate barrel construction method and materials can both extend the lifespan of the component as well as improve the product quality.

— W.M. Davis

See also:

- Barrels with integral feed throats
- Barrel and screw wear
- Further comments on barrel profiles
- Optimization of cast aluminum barrel coolers

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