Interplex

Cold Forging
Tech Bulletin

Cold Forging Technology Offers Superior Strength, Part Integrity and Material Utilization

Improved Grain Structures

This Tech Bulletin provides information on how Cold Forging processes can deliver superior product strength and material integrity as compared with conventional machining processes.

Cold forging technology is applicable for a wide variety of parts that require high-volume production and critical strength parameters in the automotive, medical aerospace, consumer products and other industry sectors.

Overview of Cold Forging

Cold forging is basically an "impact forming" process that deforms a piece of raw material plastically, under high compressive force, between a punch and a die using suitable equipment such as a machine press.

Some basic cold forging techniques include Extrusion (forward, backward, forward & backward), Coining, Upsetting, and Swaging. These techniques may take place in the same punch stroke or in separate operations, depending on the specific application requirements.

In essence, cold forging is a displacement process that forms the existing material into the desired shape as compared with conventional machining, which uses a removal process to take away material to create the desired shape.

Some of the key advantages of Cold Forging, as detailed in other Tech Bulletins, include:

- Higher Productivity for High-volumes
- Material Savings and Cost Reduction
- Improved Strength, Part Integrity and Material Utilization
- Enhanced Appearance and Surface Finishing

This Tech Bulletin focuses specifically on the Improved Strength, Part Integrity and Material Utilization aspects, including empirical results of product testing.

Material Utilization

A primary advantage of cold forging is the elimination of wasted material. Instead of removing a significant amount of the raw material, a cold forging process makes use of it all.

Input to the cold forging process is in the form of “billets” of material, which are cut from the raw stock bulk material (coil, beam, sheet, etc.). Each billet is the exact amount of material needed for the final part so there is no waste or loss of material.

As shown below, machining processes must start with a significantly larger amount of raw material than is actually used in the finished part, which results in lower material utilization rates. In contrast, cold forging material utilization rates typically approach 100 percent.

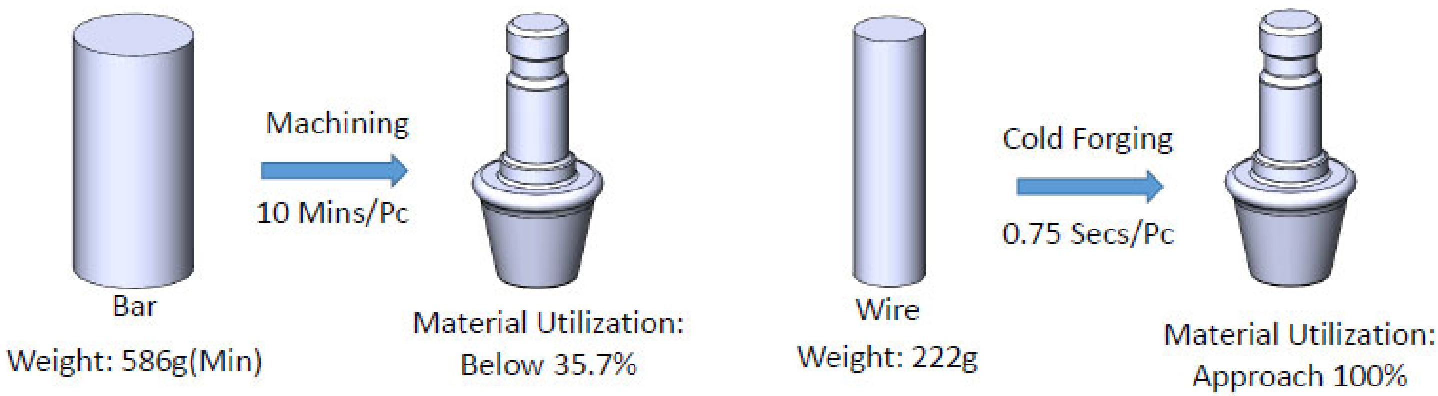

Figure 1 - Comparison of Material Utilization for Machining vs. Cold Forging

This waste-free process can offer a significant benefit in high volume production where the waste-per-part can become a key cost consideration and/or in situations where the raw material is costly, such as specialized alloys or scarce metals.

Figure 2 - Cold Forged Part

Improved Part Integrity and Strength

A very important factor is the ability of cold forging to significantly improve the strength and integrity of the final part. Forging yields much stronger parts than can be achieved with casting, weldments, or powder metal processes and it is also superior to machining of raw bar or plate metal.

The high compression process used in cold forging actually displaces and rearranges the grain of the base material such that any inherent weaknesses are eliminated. This can be particularly important for part designs where the required shape could experience weak points along the existing grain of the base material.

The types of designs where grain flow strength is critical include long protrusions that cut across the grain or complex parts with narrow points that could be prone to breakage under stress. Using a cold forging process inherently overcomes these problems by eliminating the need for engineers to worry about any issues with the underlying grain of the raw material.

The differences in grain flow are illustrated by creating the previously shown part using both machining and cold forging processes. The completed parts were then sliced in half using a wire cutting process and chemically etched to show the interior grain structure. (See Figure 3)

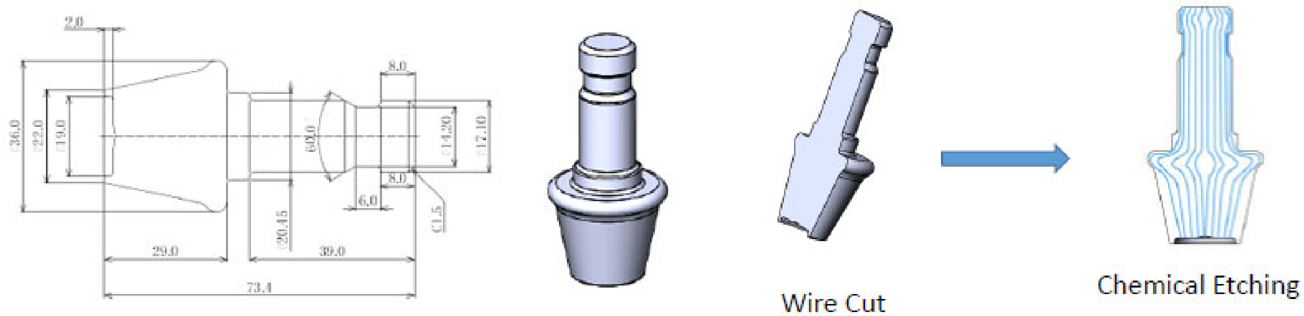

Figure 3 - Grain Structure Inspection Process

As illustrated in Figure 4, the machined part retains the unaltered grain structure of the original raw material, which creates the potential for weakness along the grain lines in the final part. In contrast, the cold forging compression process creates a reformed and strengthened grain structure to eliminate these weaknesses.

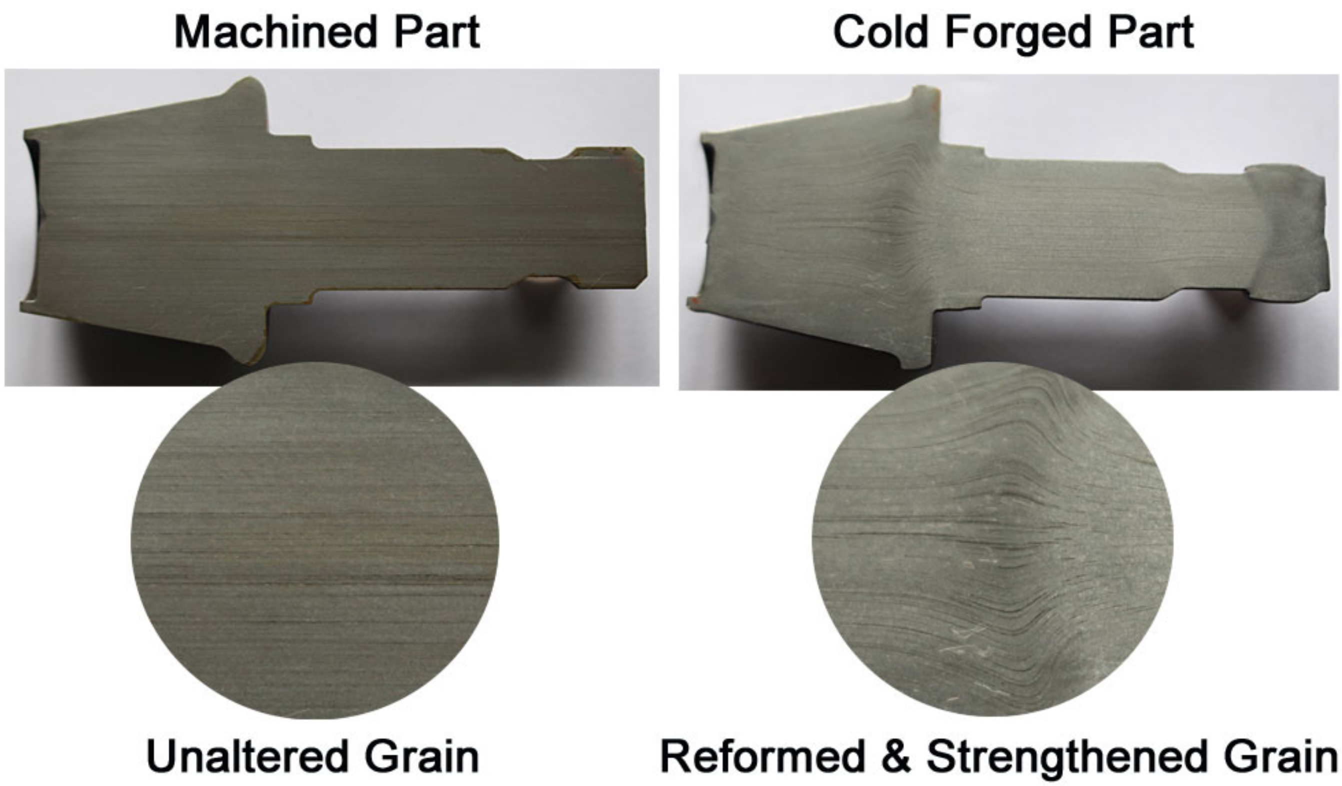

Figure 4 - Comparison of Grain Flow Structures

Summary

Understanding cold forging processes and selecting a partner with deep experience in cold forging applications, including vertical integration with other processes, can offer designers and production engineers a valuable alternative to conventional machining or casting processes.

The key to success is to start early in the design process and to consider overall production volume and ramp-up requirements so that cold forging can be leveraged for optimal ROI and quality results.

Compared with other competing technologies, such as machining, die casting, plastic injection molding, weldments, and metal injection molding (MIM), cold forging creates products with a higher impact strength, a higher structural integrity, and better accuracy while using less material. The process is highly productive and optimal for surface finishing.

Other Cold Forging Tech Bulletins:

This overview Tech Bulletin has provided an introduction to Cold Forging technology and a brief summary of its advantages in terms of productivity, material savings and strength.

Other topics covered in the Cold Forging Tech Bulletin Series include:

- Cold Forging Overview
- Comparison of Cold Forging to machining
- Comparison of Cold Forging to casting
- Comparison of Cold Forging to weldments and fabrication methods

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More information regarding cold forging technologies can be found on the web by visiting
http://www.interplex.com/services/cold-forging