AUSTEMPERING
The Leader In Austempering Technology...Applied Process™
www.appliedprocess.com
What can:

• Make high-strength, low-cost components?
• Make steel parts tough... through and through?
• Make quieter components?
• Produce parts with ultra-high wear resistance?
• Produce gears and shafts that torque off the competition?

Austempering

Austempering is an isothermal heat treatment that, when applied to ferrous materials, produces a structure that is stronger and tougher than structures produced with conventional heat treatments.

The Background On Austempering

Researchers at the US Steel laboratories in the 1930’s developed what we now commonly call the isothermal transformation (IT) diagram (Figure 1). They discovered that some steels subjected to an isothermal quenching process yielded a different microstructure and substantially higher strength and toughness when compared to conventional, martensitic materials. This microstructure of acicular (plate-like) ferrite and carbide was named “Bainite” after one of its discoverers.

In the late 1930's and early 1940's, this isothermal process, by now known as Austempering, was first applied to cast irons by researchers in US commercial laboratories, but the strength and toughness of these irons was limited by the graphite shape in the structure. In the late 1940’s, ductile iron (spheroidal graphite iron) was developed concurrently in the US and the UK. This new type of iron (“the iron that bends”) revolutionized the iron casting industry and, with its high-strength and toughness, began to replace cast and welded steels and malleable iron. It also provided the perfect vehicle for future developments.

The Austempering process was applied with good success to steel gun components during World War II but remained impractical for general industrial application due to the inefficiency of the heat treating equipment available for the process. It was not until the 1960’s that highly efficient, continuous Austempering equipment was developed. This reduced the commercial price of the Austempering process and vastly expanded its application, largely to small steel springs and stampings.

The first commercial application of Austempered Ductile Iron (ADI) came in 1972. It was a small crankshaft for a hermetically-sealed compressor. ADI, with its matrix of acicular ferrite and carbon-stabilized austenite, known as ausferrite, delivered the increased fatigue strength required for the application. However, for the first decade after that milestone, the growth of ADI applications was retarded due to the inability of the heat treating industry to cost-effectively process the material.

After five decades of Austempering metallurgical and equipment development, Applied Process Inc. was born in 1984, concurrent with the development of a new type of highly efficient, batch-Austempering plant. These units allowed fixture loading of larger parts, high quench severity, environmentally sound operation, and high production rates. Until then, thicker and larger Austempered parts had not been considered, but these developments made those parts both technically and economically viable.

In the decades since 1984, extensive internal and collaborative research conducted by Applied Process has resulted in proprietary process models and property optimization for ADI, Austempered Gray Iron (AGI), Austempered Steel, Carbo-Austempered™ Steel, and Carbide Austempered Ductile Iron (CADI). The market for tougher, stronger, lighter, quieter, and more wear resistant Austempered steels and irons continues to grow, and Applied Process™ will continue to lead the way in the development and application of the Austempering process.

Carbon Steels: 1080

FIGURE 1
Applied Process has earned a reputation as a technology leader in the heat treat industry, with a specific focus on the Austempering process. AP and its affiliated companies use properly applied Austempering technologies to solve tough engineering problems. AP also continues to work on the development of more efficient Austempering systems. This experience and capability is available to you today from the Applied Process team.

Expanding the process
With a combination of technical marketing, collaborative research and development, and reliable, value-added performance, Applied Process has worked to expand the application of Austempered Ductile Iron. With worldwide locations, AP has also expanded the application of Austempered and Carbo-Austempered™ Steel. Work is also proceeding on the development and application of Carbidic Austempered Ductile Iron (CADI).

A commitment to environmental integrity
Applied Process and its affiliates are good neighbors who lead the way in developing environmentally friendly processes. We have reduced gas consumption per pound of metal treated by 40%, and reclaim all of our quench salt, alloy, and cooling water. We use 100% recyclable materials. We have implemented technologies that reduce in-plant noise by over 50%, and are researching ways to reduce NOx emissions and further improve energy efficiency. We are a good neighbor.

Austempering Can Do It!

Carbo Austempering™
Produce Parts That Torque Off the Competition
This process develops a tough, high-carbon, bainitic case on high-performance components. Carbo-Austempered™ parts have remarkable impact properties that are superior to both neutral hardened or carburized steels. While Carbo-Austempered™ parts can have a 10-15% greater high-cycle fatigue strength, their low-cycle/high-load fatigue strength can be over 50% greater than conventionally processed materials. Carbo-Austempering™ is routinely applied to steel gears, shafts, and power transmission parts that undergo periodic overloading in service.

Austempered Ductile Iron
Make High-Strength, (ADI) Low-Cost Components
ADI provides a high strength-to-weight ratio material at a component price that is typically 20% less than that of steel or aluminum. It may surprise you to know that in some applications, ADI has replaced aluminum as a weight savings. ADI components are very competitive with steel forgings, castings, and weldments, as well as aluminum castings and forgings. Austempering can also replace induction and flame hardening as a cost savings.
Evolution of the Process

Applied Process, Inc.

In 1984, Applied Process was incorporated as a sister company of AFC-Holcroft to bring to market the heat treat processes made possible with the then-new Universal Batch Quench Austemper (UBQA) furnace technology. UBQA furnaces are controlled atmosphere batch-type furnaces integrated (under atmosphere) with a proprietary salt quenching system incorporating extreme agitation and water addition for maximum quench severity and uniformity. UBQA technology gave AP the flexibility of a batch-type furnace with the productivity of a much larger continuous furnace. It made possible the Austempering of larger, thicker steel and iron parts. It aided in the commercialization of both the Austempered Ductile Iron (ADI) process and the Carbo-Austempering™ processes.

In 1993 as the result of a friendly business spin-off, Applied Process Inc. (Livonia, Michigan, USA) became a stand-alone corporation with John R. Keough as CEO. AP expanded with the commissioning of AP Westshore in Oshkosh, Wisconsin USA in the spring of 1994. The plants operate UBQA lines with working envelopes up to 36in x 72in x 56in (900mm x 1800mm x 1400mm) and maximum gross loads of 3 tons.

Carbidic Austempered Ductile Iron (CADI)

CADI is a new material that uses a matrix of ausferrite and carbides to add strength and wear resistance to ductile iron parts. The result is a premium, engineered iron with longer life that is more wear resistant than Grade 5 ADI. Typical applications for CADI will be off-highway vehicles, agricultural equipment, railroad, construction and mining, general industrial, material handling, and ground engaging components.

In 2012 AP commissioned the Monster Parts™ Division in a newly dedicated facility in Oshkosh, Wisconsin, USA with the largest integral quench batch furnace on the planet. The Monster Parts™ UBQA has a working envelope of 84in x 96in x 56in (2100mm x 2400mm x 1400mm) and a maximum capacity of 10 tons.

Applied Process also has technical licensees worldwide; ADI Treatments (England), ADI Engineering Process and Heat Treatment (Australia), Hightemp (India) and Austemper Suzhou and Austemper Jilin in China. AP collaborates with the licensees on technical and marketing issues in our joint effort to profitably grow the pie for Austempering.

AP’s plants and licensees are supported by a fully staffed R&D effort led by a PhD metallurgist. Our R&D efforts, both internal and in the greater technical community, have led to the development of proprietary computer process models and multiple new metallurgical innovations. These innovations include materials such as Carbidic Austempered Ductile Iron (CADI™), Locally Austempered Ductile Iron (LADI™), and high-strength, bainitic (14.8) steel fasteners. Furthermore, AP has been instrumental in creating ADI standards such as those specified by ASTM, SAE, and ISO, as well as the China ADI standards. AP’s engineering efforts continue daily in the fields of process technology in ductile iron castings, machining, gear properties and the conversion of steel and aluminum castings, forgings and weldments into one-piece ADI and CADI™ castings.

Austempered Steel

Make Steel Parts Tough... Through and Through

Application of the Austempering process to steel provides the user with a tough, high-strength component that resists embrittlement. This dimensionally repeatable process is typically cost competitive with conventional quench and temper processes. Austempering is particularly appropriate for medium- and high-carbon steel stampings, forgings, castings, and full-density powdered metal parts.
Austempered Gray Iron (AGI)

Make Quieter Components

AGI offers material with excellent dampening effects, strength, and wear resistance for applications such as bearing collars, light duty gears, cylinder liners, machine parts, and brake components.

Policy Statement

Applied Process has been a technology leader in the heat treating industry since 1978. While many companies talk about quality, we have quietly designed it into our equipment and processes. Our experience shows that quality does not cost, it pays. Nor can quality be “inspected” into the finished product. It must be woven into the organizational fabric.

Our goal is to process zero defective parts. Each and every individual in our company realizes that even one substandard part or process threatens our customers and our position in the market. To that end, we continually refine and improve our processes, educate our employees, and update our facilities to assure our customers of:

The Highest Quality Services Available
On Time
At Competitive Prices

How to Get Started:

Value Engineering

To help you see the advantages of AP’s Austempering services for the parts you manufacture, AP professionals can meet with your engineers to discuss your specific needs.

We can perform material, process, and cost analyses that conclusively demonstrate the competitive advantages of Austempering for many different types of parts. We’ll even come to your facility to view it first hand and make suggestions that can help improve your product planning.

Call today for a thorough evaluation of how our processes can improve your processes...and save money for you and your customers.