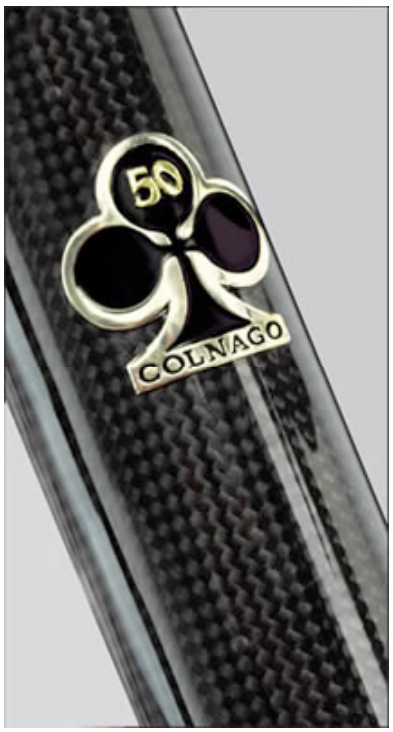
COLNAGO

TECH BULLETIN

COLNAGO'S CARBON FIBER

IT'S ABOUT WHAT'S INSIDE



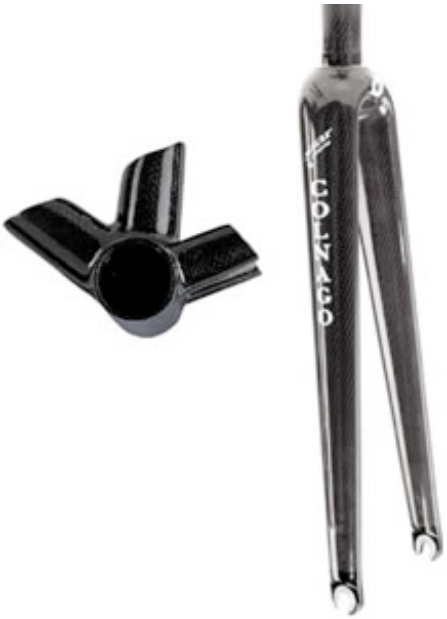
Today when one thinks of high tech material applications, carbon fibre comes to mind immediately. Carbon fibre is used in many sectors sporting goods, but often without any real know-how or specific preparation. In many cases, Colnago believes that carbon fibre is used only as a marketing gimmick. As a result, consumers can find many different types of carbon fibre products, which look the same from the outside, but inside offer a wide range of quality.

One of the best examples of this is the manufacture of bicycle frames, where the use of carbon fibre allows builders to free themselves from traditional methods used for metal bicycles such are tube filing & brazing. Using carbon fibre to build monocoque frames and complex lugs by optimising the structure enables bicycle builders to make a frame according to specific requirements of weight and performance.

At Colnago, we believe that to make informed choices and to have the best quality, performance and reliability in carbon fibre bicycles, today more than ever, it is important to know just what's inside. So allow us a brief summary of the history of carbon fibre at Colnago.。

HISTORY

Enzo Ferrari, Giuseppe Saronni, Ernesto Colnago, Vanni Brambilla.

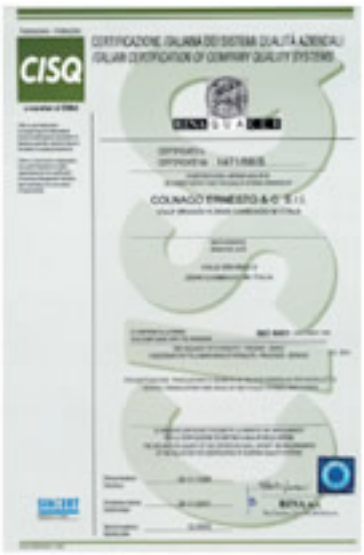


In the early 1980's, Colnago was seeking innovative new ways to build bicycle frames. Back then, use of composite materials was considered very daring, but we realized that although viewed with little knowledge and much scepticism, composites were the future of bicycle frame construction due to their high strength to weight ratio and light weight. 20 years ago, the most avant-garde industrial sectors were aerospace and Formula One. Colnago's friendship with Ferrari that got things started. "I was discussing composite materials with Enzo Ferrari one day", recalled Ernesto Colnago, "and he suggested that I work with his engineering team to develop a bicycle frame made in carbon fibre, with all the right elements that a racer needs; stiffness and stability." From the original idea, the final product took some time, because Ernesto Colnago wanted to ensure that this new material, carbon fibre composite, would have an appropriate level of safety and quality for his bicycle frames. After numerous experiments with Ferrari Engineering in 1985 to study various composite materials and applications, the data was collected and analysed. The first prototype was built in 1986 and Ferrari Engineering then brought Colnago to their key partner in composite materials fabrication, ATR srl, an emerging Italian high-tech company that specialized in carbon fiber fabrication. ATR proved to be the right choice, for two decades later, ATR now builds state-of-the-art carbon fibre components for Porsche, Aprilia, Ducati, Renault, Minardi, Agusta, besides Ferrari, Maserati, Lamborghini as well as Colnago. Partnered with ATR, Colnago's first marketable carbon fibre frame, the C-35 was launched in 1989. After the glorious Carbitubo model that followed the C-35, Ernesto Colnago designed and created the C-40 model in 1993. In 10 years, the C-40 has won almost 1000 professional races, beginning a period when sophisticated high-tech carbon

Oscar Freire, Erik Dekker, Paolo Bettini: Lisbona 2001

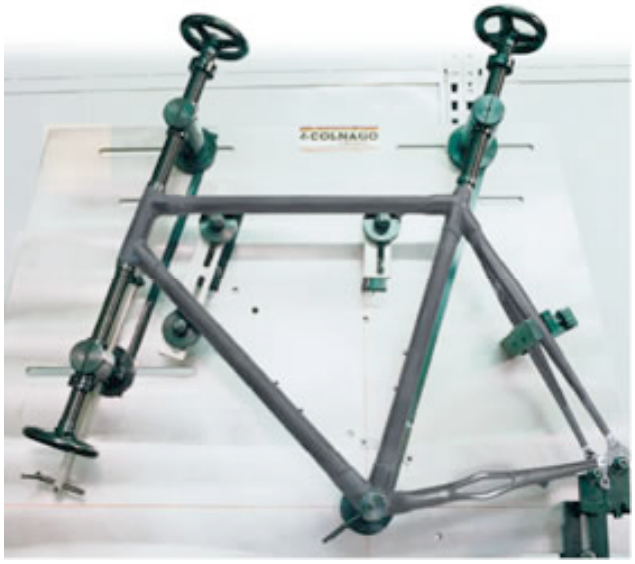
fiber bicycles became known to cyclists the world over. Monocoque carbon fibre forks, the B-Stay rear triangle and Colnago for Ferrari bikes CF1, CF2 & CF3 have further cemented Colnago's collaboration with Ferrari and ATR. Most recently, the fruits of 10 years of R&D and experience with the C-40 have created two new models; the C-50, made with monocoque lug structures and profiled tubes that now allow us to make a custom carbon fibre frame for professional and amateur riders alike. Our ANNIVERSARY model, created to celebrate 50 years of Ernesto Colnago's esteemed bicycle design & construction, blends art and science with it's monocoque front triangle mated to our B-Stay rear triangle with High Power chainstays.

TECHNIQUE & TECHNOLOGY

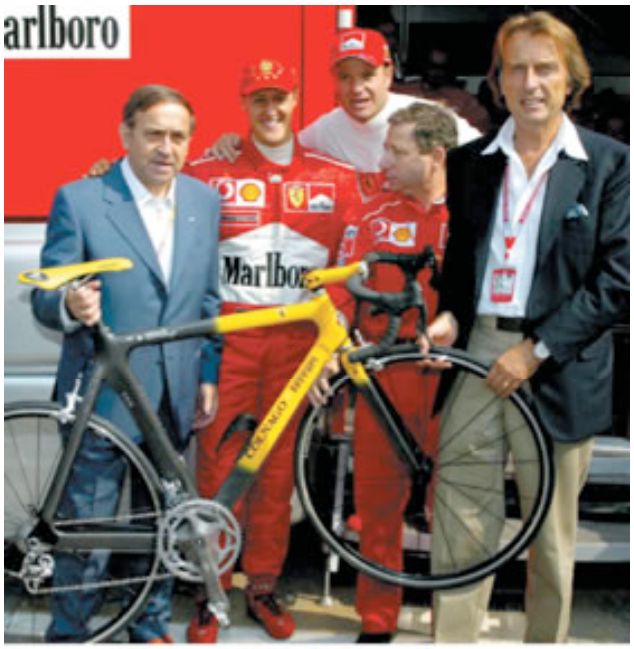


When one talks about composite materials, simply put, this means material that has been created by uniting two or more raw materials, so that at the end of the production process, you can't separate the original raw materials. Composite materials are very complex; more complex than metals. Composite materials can be a mixture of high strength fibers and a matrix (resin) which binds the fibers together. The most utilized composite material is wood and from this comes the basic concepts to use synthetic materials. In wood, the raw materials are resin and fiber. So it's simple to understand that the task of resin in composite is to keep the fibre in position. In other words, the resin maintains the shape and the fibre provides the mechanical characteristics.

There are many complex processes to produce both the carbon fibre and resin. Carbon fibre materials are made from polymers by ever more refined production techniques. These carbon-polymer composites consist of carbon fibres, either unidirectional, woven or knitted or 3-Dimensional embedded in a polymer matrix. The more production techniques that are used to produce the carbon fibre, the more complex and specific the fibres become as well as equally increasing their quality.



When you are talking about carbon-polymer composites (which are made from precursor materials like PAN: polyacrylonitrile), they undergo many processes to refine them prior to use, such as heating in industrial ovens to very high temperatures (pyrolysis) and then tensioning to create carbon fibres of around one micron in diameter that have extremely high axial strength. The epoxy resins that are used are of two types: thermoset and thermoplastic. Thermoplastics are still in the development phase due to inability to produce them economically. So thermoset resins are used to pre-coat or pre-impregnate (pre-preg) the carbon fibres, which become hardened once they are heated. The process when carbon fibre and resin are joined into a matrix is called polymerisation.



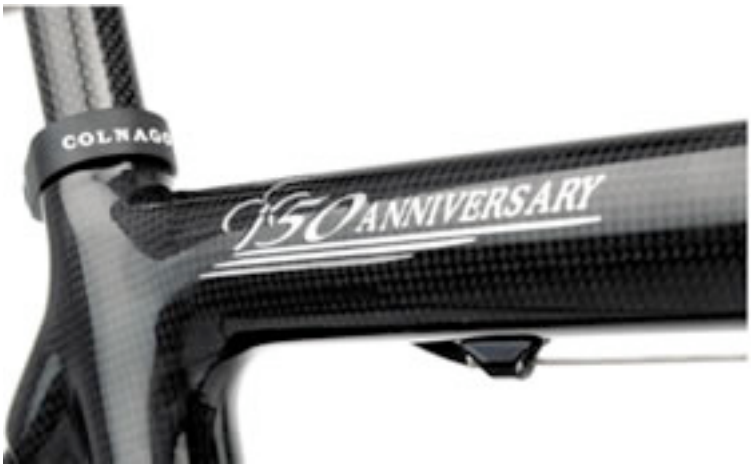
Ernesto Colnago, Michael Shumacher, Jean Todt, Rubens Barrichello, Luca Cordero di Montezemolo.

It's the job of the engineer to take advantage of the ability of unidirectional carbon-polymer composites that resist torsion only along their axis, so the correct orientation of the fibres is the basis of the structural behavior of composite material. With composites, you can create the exact characteristics required in each tube or structure. Stiff in torsion, soft in bending, or combinations thereof. The engineer determines the characteristics, not the the material,

which is called anisotropy, and this can't be done with metal. So to ensure the utmost application of carbon fibre technology to bicycle design, Colnago collaborates with Dr. Giuseppe Sala of the Aerospace Engineering Department of the Milano Polytechnic Institute and the Research & Development Lab of ATR by using Finite Element Analysis (FEA) to optimise the distribution and positioning of the fibre within the polymer matrix. This allows Colnago to find the potential weak points in a design and strengthen the right areas as needed.

There are many similarities between the textile industry (fabrics, carpets, etc) and composite materials. Using the same techniques as textile manufacturers, carbon fibre fabric is created with weave and warp, then overlaid (laid up) in a mold via a lamination process to achieve different mechanical characteristics from the original properties of the carbon fibre material. For example, interweaving the fibres at 90°, will behave in a similar way in both perpendicular directions and also a good behavior at a 45° angle to the other two directions.

Colnago is certain that this clearly illustrates that to produce safe, high quality and high performance carbon fibre composite bicycle frames, a meticulous research & development process must be followed to create an optimal composite structure. Above all, this comes from the quality of the carbon fibre composite used which ultimately provides the safety, high quality and high performance required in the final product from Colnago.



Besides the obvious importance of the quality of the carbon composite materials, production technology is equally important. The best way to manufacture high-quality carbon composite components is in an autoclave oven that uses high heat and pressure. Pre-preg carbon composite fabric that is layed up in moulds then undergoes polymerisation. Another method used to create carbon composite components is via a moulding press with heated platens. But the fundamental difference between autoclave and heat press is that in the autoclave, heat and pressure is uniform throughout the mould, while on the press, heat and pressure are inevitably vary along the axis of the press. So the

choice of the production method for composite materials comes from the different tasks the component is expected to perform. The concept is: 1.the shape of the frame is complex; 2. the thickness of the carbon fibre is variable in each specific zone of the frame.

It is also important to define what is meant by monocoque. The dictionary says that monocoque is “a type of (racing-cycle) in which all or most of the loads are taken by the skin; a design with no separate chassis and body.” A bicycle frame that is defined as monocoque is made in one unique operation. So when we at Colnago are talking about monocoque components like forks, lugs & frames, we mean when the component is made completely in carbon fibre and produced in one polymerisation.

That way, one can always be certain of the fundamental quality of Colnago frames and forks, which are created only after exhaustive research and development, manufactured in the highest quality carbon fibre composites via state of the art methods where safety, quality and performance are the hallmarks.

Moreover, Colnago is one of the only bicycle manufacturers worldwide certified ISO 9001. ISO (International Organization for Standardization) is the only world-wide organization that guarantees and certifies the attainment and maintenance of quality standards in design (the safety and quality of materials used in production) as well as in every element of production. Once a company attains ISO 9001 certification, it must be maintained year after year, requiring a continual investment in resources and process management.

In conclusion, we at Colnago are happy to affirm that the choice of a Colnago carbon fibre bicycle means that you are chosing a safe, high-quality and high-performance product that comes from 19 years of experience and more than 1000 pro race wins on our carbon fibre bicycles. Colnago carbon fibre bicycles are authentically “Made In Italy”; not only for the great design, but above all for the technique and technology one finds inside each and every one.

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