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Fiber Glass—Its Future in Belted Tires

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Synopsis

The rapid success of fiber glass-belted tires (from very low production in 1966 to one hundred million units in 1971) is discussed in terms of specific cord properties. The inherent glass characteristics of high modulus, high tensile strength, and low elongation are shown to be ideal for belted tires. Applications of fiber glass for belts of light commercial and heavy-duty tires are discussed. The opportunity for developing new fiber glass cords which offer improved cost/performance characteristics are explored, including cord geometry and fiber diameter. The cost/performance capabilities of fiber glass for use in radial tires, both in the belt and in the carcass, are discussed as additional future opportunities. Laboratory and road test information is detailed and outlined. Ride aesthetics of the all-glass radial tire design is emphasized. The market penetration for fiber glass tire cord will be projected through 1980.

I must admit, gentlemen, that if I had stood on this spot in 1965, just seven years ago, and forecast that fiber glass would be a dominant tire reinforcement within two or three years, you would have probably laughed me off the stage. Yet that prediction has come true.

So, I hope you will take me seriously when I make some projections about the increased use of fiber glass in radial tires, a little later in this talk. For I am confident that five years from now, I will be able to stand on this stage and confirm that fiber glass is still a dominant tire reinforcement. But first, just let me review the history of fiber glass tires briefly.

HOW FIBER GLASS USAGE GREW

The first commercial tires to use fiber glass reinforcements—the belted bias design—were introduced in 1966. During that year, 200,000 units were produced and marketed. That number grew to 66 million units in 1970. Today, over 75% of the original equipment tires are fiber glass belted—over 34 million units. An additional 53 million belted tires are sold in the aftermarket.

In explaining the phenomenal growth of belted bias tires, two factors are usually cited. One is Goodyear's conversion to the Polyglas tire in early 1967. The second is General Motors' decision to make the belted bias tire standard on its 1969 cars.

These decisions were based on the availability of a fully developed tire. They could not have been made without the pioneering efforts of others.

Joe Stewart, now Chairman of Armstrong, was the first to recognize the potential of belted bias tires. He overruled those who maintained the public would not pay up to 20% more for a tire. He was convinced that the motorist would pay more for a tire if it lasted longer, reduced fuel consumption, and improved the vehicle's handling and ride.

The early gains won by Armstrong and Sears would not have swept the industry, however, had it not been for a group of chemists and rubber engineers at Goodyear. They, and soon the remainder of the industry, recognized that there was more to building a belted bias tire than just adding a belt to a bias tire. They approached the belted bias tire as a completely new concept in which design, rubber compounding, and reinforcements were optimized to produce a tire with the best cost–performance ratio.

When this group looked at the belted bias ply design, they discovered that properties required in a tire reinforcement had changed. In the bias ply design, the carcass, which acts as an air envelope, places a premium on endurance, dimensional stability, tensile strength, and low heat generation. Through the years, cotton, rayon, nylon, and, more recently, polyester had fulfilled these traditional requirements.

In the belted bias ply tire, a new set of tire reinforcement criteria are introduced. The belt must stabilize the tread area to eliminate squirm and extend tire life. Modulus, yield under stress, bulk, and weight become the new tire reinforcement criteria.

Fiber glass combines these properties with low cost for unequaled cost–performance. Glass was chosen and remains the dominant belt reinforcement because it has a marked superiority over organic cords.

It is interesting to note that fiber glass-belted tire sales have increased while rayon-belted bias tires are disappearing from the market even though glass belts cost more than the comparable rayon units. The reason is simple. Fiber glass-belted tires substantially outperform their rayon-belted counterparts. This added performance more than offsets the extra cost of the tires. In other words, the fiber glass tire has a superior cost–performance ratio.

The consumer, who ultimately controls the market place, recognizes cost–performance as a cost–benefit advantage. He is willing to pay extra for the fiber glass tire because it lasts longer and wears better. He spends more initially but he gains more for every dollar spent.

The cost–performance edge of belted bias tires has been maintained by a continuing series of improvements in fiber glass tire cord systems. The first commercial fiber glass tire cords were made of multiple strands.

Recently, Owens-Corning introduced a new cord concept, a single-end 2000-filament strand, known as G15 1/0. Though very similar to the old multistrand cord, the properties of the single strand cord are more uniform. This increase in reinforcement uniformity improves the flex endurance and property retention characteristics of the single strand cord.

When the new cord is designed into a tire with modifications in compounding and production techniques, tire performance improves significantly. In road tests designed to promote belt failure, tires with the single strand cord have a 6–7 rating. This is compared with early production of tires which had a rating of 3. A rating of 7 means there are no failures in the belt cords.

By the end of 1973, we expect to have developed a new high-performance fiber glass cord system with improved adhesive chemistry and optimized cord geometry. The new cord system will have an improved strength-to-weight ratio and extended flex endurance. Both these improvements will strengthen the cost–performance advantage fiber glass brings to a tire.

Improving the performance of a tire cord is not the only way to maintain the competitive edge of fiber glass. Owens-Corning has been reducing the price of fiber glass since 1969. Today, it costs 78¢/lb, almost 25¢ less per lb than in 1966. We foresee further price reductions in the future. (Or, stated another way, with constant inflation on costs, we see fiber glass tire cord holding the price line.) It is the same unique combination of properties and cost effectiveness that makes me confident that fiber glass will be widely used in radial tires.

Today, most tire manufacturers are racing to catch up with Michelin who have 25 years experience developing radials. Many manufacturers are designing tires to match this European tire feature for feature. They think steel because the performance bogey is Michelin, and Michelin uses steel belts. As a result, tires are being evaluated on a cost–feature basis.

The "consumer oriented" market we are in today won't buy the "feature" approach very long. Today's consumers want value for their money.

The belted bias tire proved that in the final analysis it is the cost–performance ratio that counts. If the performance justifies the cost, the customer is willing to pay for it.

To optimize its cost–performance ratio, the radial tire must be considered as a completely new tire design. At Owens-Corning, we have examined the radial tire in much the same way as we looked at the belted bias tire when it was introduced.

We found that the belts in a radial tire perform essentially the same task as the belts in a belted bias tire—stabilizing the tread to prevent excessive wear. As experience in the last five years has shown, fiber glass is an ideal belt material which outperforms all organic cords.

Fiber glass is also more than competitive with steel cords. Cost and weight savings are possible since less fiber glass is used to obtain equivalent belt performance.

The cost effectiveness of fiber glass in the belts of radial tires was confirmed recently by the introduction of a glass/rayon radial tire in Michelin's own backyard. According to Kleber, France's number 2 tire maker, their V10 GTS tire offers increased traction, reduced wear, and less heat buildup. A similar glass-belted radial has been fitted successfully on cars that have

won the Monte Carlo Rally and the Chamonix Winter Rally in the 1971–72 season.

Our review of the radial design also revealed that the high cross-sectional strength of glass makes possible a one-ply glass-reinforced carcass. The single-ply glass carcass more than matches the performance offered by the two plies of rayon, nylon, or polyester.

The result of our development work is a unique 1-plus-2, all-glass radial tire design that makes optimum use of fiber glass properties.

Briefly, the 1-plus-2, all-glass radial has an inner liner of two conventional laminated plies. A rubber-impregnated chopped strand squeegee is positioned between the liner plies and the carcass. The squeegee prevents the carcass cord from pulling through the inner liner during curing and forms an additional barrier to foreign object penetration.

The single ply carcass is reinforced with the new single strand cord discussed earlier. Essentially, the same fabric is used for the two belts. Although remaining tire components follow accepted industry practice, one of the keys to the success of the new 1-plus-2 design is the selection of rubber formulations for the sidewalls and tread.

Now let's discuss the cost and performance of the all-glass radial.

The 1-plus-2 construction requires less than half the cord of comparable steel organic radial tires. Reinforcement savings up to 40% are projected. These savings may not be quite that large since they may be partially offset by other tire-processing costs. There remains, however, an opportunity for measurable savings.

Now, to performance. Independent testing has confirmed the 1-plus-2, all-glass tires are a match for the best radials. Durability is equal to the best radials, 35,000–40,000 miles under severe test conditions. These test results are projected to 70,000 miles under road conditions. In abuse testing, glass belts with broken cords have outperformed organic belts with undamaged cords.

Ride is not as easy to measure as tread wear. Independent observers have confirmed the superiority of the soft ride of the all-glass radials. The smoothness of the ride is particularly evident at low speeds where other radials tend to be very harsh.

All-glass radials with the 1-plus-2 construction are currently being developed by all the major tire companies—evidence that fiber glass has a role in the mainstream of the radial tire market.

Our experience with the all-glass radial has pointed up the benefits of fiber glass as a carcass reinforcement. In fact, some radial tire development programs have begun using fiber glass in the carcass and other materials in the belt.

So, fiber glass has three different opportunities to participate in the radial tire market: as the belt reinforcement over an organic carcass; in both the belt and carcass in an all-glass, 1-plus-2 tire; and in the carcass of a radial tire belted with another material.

I am sure you have your own projections of tire sales during the next five years, but I would like to show you how we see the market shaping up. Like most other industry observers, we see radial tire sales growing from just over 13 million in 1972 to 45 million in 1975. The vast majority of the market—53.6%, or 122 million units—will remain fiber glass-belted bias tires.

Of the 45 million radials sold in 1975, we believe that, conservatively, over 6 million will use fiber glass as a reinforcement.

I say conservatively, for I believe that when engineers, including those here today, take up the challenge to optimize the radial tire for cost–performance, the result will be an increased use of fiber glass. As engineers, your influence on the tire market is greater than that of marketing experts and advertising agencies. You can provide the leadership necessary to produce a tire that offers the consumer the most for his money. Fiber glass is the major belt reinforcement in the belted bias tire market because of its cost benefits. For this same reason, I expect fiber glass to occupy the broad middle segment of the radial tire market.