

Research and Development at Kobe Steel on Materials and Technologies for Automobiles

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The number of automobiles in the world exceeded 850 millions in 2003, as motorized vehicles became more widespread throughout the world. The United Nation estimates that the number will rise to 1.6 billion around 2030 due to the booming car market, especially in the BRIC countries (Brazil, Russia, India, and China).

As the number of vehicles increases, our society needs to respond to new challenges including environmental and safety issues, such as "prevention of global warming" and "protection of occupants, as well as pedestrians".

Japan is obliged by the Kyoto Protocol, effective in 2005, to reduce its greenhouse gas emissions by six percent below the 1990 level between 2008 and 2012. This has led to various initiatives involving automotive weight reduction to improve fuel economy. However, as a consequence of safety standards which are becoming increasingly stringent in major global markets (Japan, USA, EU), automobiles are required to have tougher structures to provide protection to occupants, and such structures potentially increase weight. Thus, the automobile industries need to compromise between the two contradicting issues of weight reduction and higher strength. In addition, the industries have to respond to the diversification of energy sources, including conventional petroleum-based fuel, bio-ethanol, electricity, fuel cells, etc.

In response to these changing social needs, Kobe Steel has been striving to implement new materials and associated technologies, such as "high performance materials", "advanced evaluation technologies", "automotive part structure optimization" and "processing technologies for such materials and parts". The implementation is based on the company's competence cultivated during its one hundred years' history in the business fields of steel, aluminum & copper, and welding. This special issue introduces Kobe Steel's activities to support automobile industries as a material manufacturer. The papers overview the company's R&D activities from two technological aspects; technology ready to be applied in the market and technology expected to provide breakthroughs to the industries in the mid-to-long term.

For steel, Kobe Steel focuses on the state-of-the-art technologies, such as improvement of the formability and phosphatability of 780 MPa grade, high-strength steel sheets used for body and seat frames. Such steel

sheets enable automobiles to have light weight and higher strength at the same time. Also, new microstructures are being developed so that such high-strength steel sheets may be formed into complex shapes of automotive parts. A new press technology, developed uniquely by Kobe Steel, has enabled ultra-high-strength steel sheets to be formed with high dimensional accuracies. The technology is expected to increase applications of high-strength steel sheets. With regard to safety, the company has developed, for example, a hot-rolled steel sheet which can be quenched to have sufficiently high strength for use with door impact beams. For long term perspective, a new concept is being pursued which combines a high-strength material and roll-forming process to realize a new vehicle design.

Aluminum alloys are increasingly used in automobile bodies because of their lightness. Kobe Steel also has developed new aluminum technologies. The company has been working on the improvement in both the properties and formabilities of 5000 and 6000 series aluminum alloys for body panels. In addition, higher strength, 6000 and 7000 series alloys are being developed for automotive safety structures. Furthermore, high-performance aluminum alloy forgings, as well as their designing and processing technologies, are being developed for automotive suspensions.

Conventionally, much effort has been applied to the development of joining technologies of similar materials such as between high-strength steels or between aluminum alloys. In response to the growing needs for "hybrid structures", Kobe Steel has also been developing technology for joining dissimilar materials, e.g., between steels and aluminum alloys, to facilitate material selections in the design of much lighter, next-generation automotive bodies.

A variety of materials and technologies, having different properties and values, are used in automobiles. This is because each automobile company applies a unique design concept for each model depending on the requirements for the car's performance, cost and parts availability. Kobe Steel aims to offer a line of products and services that are optimized for each design concept. The company aims to provide not only materials, such as steel, aluminum and welding materials, but also various services and technologies including welding

technologies and evaluation technologies.

Kobe Steel's mission is to keep offering new products and services which can contribute to the success of its customers. The company will keep striving to develop new, unique products and

technologies, and thus contribute to the further development of automobile industries. We greatly appreciate opinions, advice and suggestions from customers to guide our development programs.